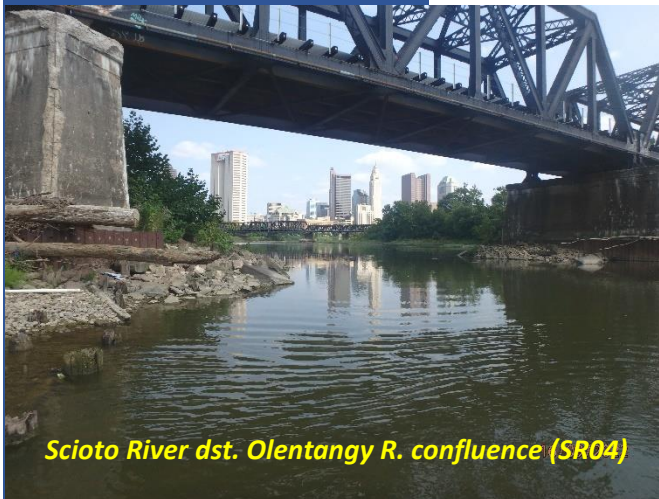
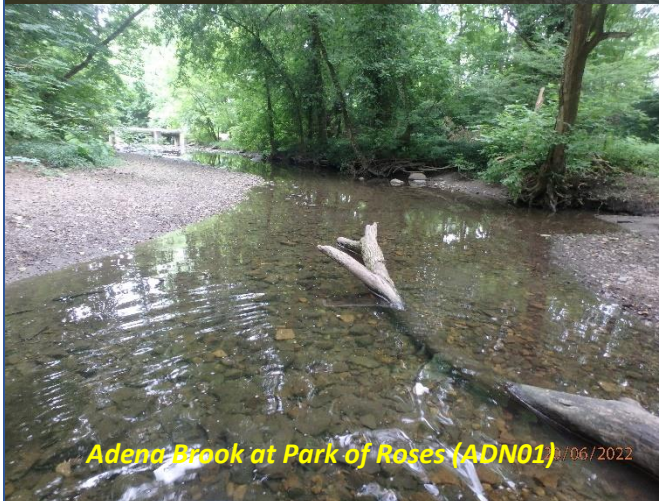

Biological and Water Quality Assessment of the Middle Scioto River, Lower Olentangy River, and Lower Olentangy Tributaries 2022



Scioto River dst. Olentangy R. confluence (SR04)



Olentangy R. ust. I-270N (OLN08)



Adena Brook at Park of Roses (ADN01) 06/2022



Relict mussels in Scioto R. at Shelly Materials (SR09)

Trent A. Dougherty, Executive Director
Jim Lane, Board President

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Biological and Water Quality Assessment of the Middle Scioto River, Lower Olentangy River, and Lower Olentangy Tributaries 2022

Delaware, Franklin, and Pickaway Counties, Ohio

MBI Technical Report MBI 2023-12-12

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Glossary of Terms

Ambient Monitoring	Sampling and evaluation of receiving waters not necessarily associated with episodic perturbations.
Aquatic Assemblage	An association of interacting populations of organisms in a given waterbody, for example, the fish assemblage or the benthic macroinvertebrate assemblage.
Aquatic Community	An association of interacting assemblages in a given waterbody, the biotic component of an ecosystem.
Aquatic Life Use (ALU)	A beneficial use designation in which the waterbody provides suitable habitat for survival and reproduction of desirable fish, shellfish, and other aquatic organisms; classifications specified in State water quality standards relating to the level of protection afforded to the resident biological community by the custodial State agency.
Assemblage	Refers to all of the various species of a particular taxonomic grouping (e.g., fish, macroinvertebrates, algae, submergent aquatic plants, etc.) that exist in a particular habitat. Operationally this term is useful for defining biological assessment methods and their attendant assessment mechanisms, i.e., indices of biotic integrity (IBI), O/E models, or fuzzy set models.
Attainment Status	The state of condition of a waterbody as measured by chemical, physical, and biological indicators. Full attainment is the point at which measured indicators signify that a water quality standard has been met and it signifies that the designated use is both attained and protected. Non-attainment is when the designated use is not attained based on one or more of these indicators being below the required condition or state for that measure or parameter.
Attribute	A measurable part or process of a biological system.
Beneficial Uses	Desirable uses that acceptable water quality should support. Examples are drinking water supply, primary contact recreation (such as swimming), and aquatic life support.

Benthic Macroinvertebrates	Animals without backbones, living in or on the substrates, of a size large enough to be seen by the unaided eye, and which can be retained by a U.S. Standard No. 30 sieve (0.595 mm openings). Also referred to as benthos, infauna, or macrobenthos.
Best Management Practice	An engineered structure or management activity, or combination of these that eliminates or reduces an adverse environmental effect of a pollutant, pollution, or stressor effect.
Biological Assessment	An evaluation of the biological condition of a waterbody using surveys of the structure and function of a community of resident biota; also known as bioassessment. It also includes the interdisciplinary process of determining condition and relating that condition to chemical, physical, and biological factors that are measured along with the biological sampling.
Biological Criteria (Biocriteria)	<p><u>Scientific meaning</u>: quantified values representing the biological condition of a waterbody as measured by structure and function of the aquatic communities typically at reference condition; also known as biocriteria.</p> <p><u>Regulatory meaning</u>: narrative descriptions or numerical values of the structure and function of aquatic communities in a waterbody necessary to protect a designated aquatic life use, implemented in, or through state water quality standards.</p>
Biological Condition Gradient	A scientific model that describes the biological responses within an aquatic ecosystem to the increasing effects of stressors.
Biological Diversity	Refers to the variety and variability among living organisms and the ecological complexes in which they occur. Diversity can be defined as the number of different taxa and their relative frequencies. For biological diversity, these taxa are organized at many levels, ranging from complete ecosystems to the biochemical structures that are the molecular basis of heredity. Thus, the term encompasses different ecosystems, species, and genes; also known as biodiversity.

Biological Indicator	An organism, species, assemblage, or community characteristic of a particular habitat, or indicative of a particular set of environmental conditions; also known as a bioindicator.
Biological Integrity	The ability of an aquatic ecosystem to support and maintain a balanced, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitats within a region (after Karr and Dudley 1981).
Biological Monitoring	The use of a biological entity (taxon, species, assemblage) as a detector and its response as a measure of response to determine environmental conditions. Ambient biological surveys and toxicity tests are common biological monitoring methods; also known as biomonitoring.
Biological Survey	The collection, processing, and analysis of a representative portion of the resident aquatic community to determine its structural and/or functional characteristics and hence its condition using standardized methods.
Clean Water Act (CWA)	An act passed by the U.S. Congress to control water pollution (formally referred to as the Federal Water Pollution Control Act of 1972). Public Law 92-500, as amended. 33 U.S.C. 1251 et seq.; referred to herein as the CWA.
CWA Section 303(d)	This section of the Act requires States, territories, and authorized Tribes to develop lists of impaired waters for which applicable water quality standards are not being met, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters. States, territories, and authorized Tribes are to submit their list of waters on April 1 in every even-numbered year.
CWA Section 305(b)	Biennial reporting required by the Act to describe the quality of the Nation's surface waters, to serve as an evaluation of progress made in maintaining and restoring water quality, and describe the extent of remaining problems.

Criteria	Limits on a particular pollutant or condition of a waterbody presumed to support or protect the designated use or uses of a waterbody. Criteria may be narrative or numeric and are commonly expressed as a chemical concentration, a physical parameter, or a biological assemblage endpoint.
DELT Anomalies	The percentage of Deformities, Erosions (e.g., fins, barbels), Lesions and Tumors on fish assemblages (DELT). An important fish assemblage attribute that is a commonly employed metric in fish IBIs.
Designated Uses	Those uses specified in state water quality standards for each waterbody or segment whether or not they are being attained.
Disturbance	Any activity of natural or human causes that alters the natural state of the environment and its attributes and which can occur at or across many spatial and temporal scales.
Ecological integrity	The summation of chemical, physical, and biological integrity capable of supporting and maintaining a balanced, integrated adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of natural habitats in the region.
Ecoregion	A relatively homogeneous geographical area defined by a similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables; ecoregions are portioned at increasing levels of spatial detail from level I to level IV.
Existing Use	A use that was actually attained in a waterbody on or after November 28, 1975, whether or not they are included in the state water quality standards (November 28, 1975 is the date on which U.S. EPA promulgated its first water quality standards regulation in 40CFR Part 131). Existing uses must be maintained and cannot be removed.
Index of Biotic Integrity (IBI)	An integrative expression of site condition across multiple metrics comprised of attributes of a biological assemblage. It refers to the index developed by Karr (1981) and explained by Karr et al. (1986). It has been used to express

the condition of fish, macroinvertebrate, algal, and terrestrial assemblages throughout the U.S. and in each of five major continents.

MIwb

The Modified Index of Well-Being (MIwb) is based on fish assemblage measures including numbers, biomass, and two diversity indices (Shannon Index) based on numbers and biomass. The numbers and biomass metrics exclude highly tolerant species. It reflects the overall productivity and diversity of the fish assemblage and it frequently responds before the IBI to improvements in water quality and habitat.

Metric

A calculated term or enumeration representing an attribute of a biological assemblage, usually a structural aspect, that changes in a predictable manner with an increased effect of human disturbance.

Monitoring and Assessment

The entire process of collecting data from the aquatic environment using standardized methods and protocols, managing that data, analyzing that data to make assessments in support of multiple program objectives, and disseminating the assessments to stakeholders and the public.

Multimetric Index

An index that combines assemblage attributes, or metrics, into a single index value. Each metric is tested and calibrated to a scale and transformed into a unitless score prior to being aggregated into a multimetric index. Both the index and metrics are useful in assessing and diagnosing ecological condition.

Narrative Biocriteria

Written statements describing the narrative attributes of the structure and function of aquatic communities in a waterbody necessary to protect a designated aquatic life use.

Natural Condition

This includes the multiplicity of factors that determine the physical, chemical, or biological conditions that would exist in a waterbody in the absence of measurable impacts from human activity or influence.

Numeric Biocriteria	Specific quantitative and numeric measures of the structure and function of aquatic communities in a waterbody necessary to protect a designated aquatic life use.
Qualitative Habitat Evaluation Index	A qualitative habitat evaluation assessment tool that is applied to streams and rivers in Ohio and which is used to identify habitat variables that are important to attainment of the Ohio biological criteria.
Reference Condition	The condition that approximates natural, unimpacted, or best attainable conditions (biological, chemical, physical, etc.) for a waterbody. Reference condition is best determined by collecting measurements at a number of sites in a similar waterbody class or region under minimally or least disturbed conditions (by human activity), if they exist. Since undisturbed or minimally disturbed conditions may be difficult or impossible to find in some states, least disturbed conditions, combined with historical information, models or other methods may be used to approximate reference condition as long as the departure from natural or ideal is comprehended. Reference condition is used as a benchmark to establish numeric biocriteria.
Reference Site	A site selected to represent an approximation of reference condition and by comparison to other sites being assessed. For the purpose of assessing the ecological condition of other sites, a reference site is a specific locality on a waterbody that is minimally or least disturbed and is representative of the expected ecological condition of other localities on the same waterbody or nearby waterbodies.
Regional Reference Condition	A description of the chemical, physical, or biological condition based on an aggregation of data from reference sites that are representative of a waterbody type in an ecoregion, subregion, bioregion, or major drainage unit.
Stressors	Physical, chemical, and biological factors that can adversely affect aquatic organisms. The effect of stressors is apparent in the biological responses.
Use Attainability Analysis (UAA)	A structured scientific assessment of the physical, chemical, biological or economic factors affecting attainment of the uses of waterbodies.

Use Classes	A broad capture of a designated use for general purposes such as recreation, water supply, and aquatic life.
Use Subclasses	A subcategorization of use classes into discrete and meaningful descriptions. For aquatic life this would include a hierarchy of warmwater and cold water uses and additional stratification provided by different levels of warmwater uses and further stratification by waterbody types.
TALU Based Approach	This approach includes tiered aquatic life uses (TALU) based on numeric biological criteria and implementation via an adequate monitoring and assessment program that includes biological, chemical, and physical measures, parameters, indicators and a process for stressor identification.
Tiered Aquatic Life Uses (TALUs)	<p><u>As defined:</u> The structure of designated aquatic life uses that incorporates a hierarchy of use subclasses and stratification by natural divisions that pertain to geographical and waterbody class strata. TALUs are based on representative ecological attributes and these should be reflected in the narrative description of each TALU tier and be embodied in the measurements that extend to expressions of that narrative through numeric biocriteria and by extension to chemical and physical indicators and criteria.</p> <p><u>As used:</u> TALUs are assigned to water bodies based on the protection and restoration of ecological potential. This means that the assignment of a TALU tier to a specific waterbody is done with regard to reasonable restoration or protection expectations and attainability. Hence knowledge of the current condition of a waterbody and an accompanying and adequate assessment of stressors affecting that waterbody are needed to make these assignments.</p>
Total Maximum Daily Load (TMDL)	The maximum amount of a pollutant that a body of water can receive while still meeting water quality standards. Alternatively, a TMDL is an allocation of a water pollutant deemed acceptable to attain the designated use assigned to the receiving water.

Water Quality Standards (WQS)

A law or regulation that consists of the designated use or uses of a waterbody, the narrative or numerical water quality criteria (including biocriteria) that are necessary to protect the use or uses of that particular waterbody, and an antidegradation policy.

Water Quality Management

A collection of management programs relevant to a water resource protection that includes problem identification, the need for and placement of best management practices, pollution abatement actions, and measuring the effectiveness of management actions.

List of Acronyms

AAV	Area of Attainment Value
ADV	Area of Degradation Value
ALU	Aquatic Life Use
BCG	Biological Condition Gradient
BNA	Base Neutral Acid Compound
CEPT	Chemically Enhanced Primary Treatment
CSO	Combined Sewer Overflow
CWA	Clean Water Act
DELT	Deformities, Erosions, Lesions, and Tumors (fish)
DOSD	Division of Sewers and Drains
DOW	Division of Water
DPU	Department of Public Utilities
ECC	Environmental Control Center
ECOS	Ohio EPA database framework used by MBI
EPA	Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, Trichoptera
EWH	Exceptional Warmwater Habitat
HD (or H-D)	Hester Dendy artificial substrate sampler
HHEI	Headwater Habitat Evaluation Index
IBI	Index of Biotic Integrity for fish assemblages
ICI	Invertebrate Community Index

IPS	Integrated Prioritization System
LEAPS	Liquid Effluent Analysis Processing System
LOT	Lower Olentangy Tunnel
LIMS	Laboratory Information Management System
M&A	Monitoring and Assessment
MBI	Midwest Biodiversity Institute
MIwb	Modified Index of Well-Being
NPDES	National Pollutant Discharge Elimination System
OAC	Ohio Administrative Code
OARS	OSIS Augmentation Relief Sewer
OCDL	Ohio Credible Data Law
ORC	Ohio Revised Code
OSIS	Olentangy Scioto Interceptor Sewer
OWEA	Ohio Water Environment Association
PAH	Polycyclic Aromatic Hydrocarbon
PCR	Primary Contact Recreation
PSP	Project Study Plan
QAPP	Quality Assurance Program Plan
QDC	Qualified Data Collector
QHEI	Qualitative Habitat Evaluation Index
RDII	Rainfall Derived Inflow & Infiltration
SCR	Secondary Contact Recreation

STV	Statistical Threshold Value
SWIMS	Surface Water Information Management System
TALU	Tiered Aquatic Life Use
TMDL	Total Maximum Daily Load
UAA	Use Attainability Analysis
VOC	Volatile Organic Compound
WLA	Waste Load Allocation
WMAO	Water Management Association of Ohio
WQS	Water Quality Standards
WWH	Warmwater Habitat
WWMP	Wet Weather Management Plan
WWTP	Wastewater Treatment Plant

FOREWORD

What is a Biological and Water Quality Survey?

A biological and water quality survey, or “biosurvey”, is an interdisciplinary monitoring effort coordinated on a waterbody specific or watershed scale. This may involve a relatively simple setting focusing on one or two small streams, one or two principal stressors, and a handful of sampling sites or a much more complex effort including entire drainage basins, multiple and overlapping stressors, and tens of sites. The latter is the case with this study in that the Scioto River represents a major drainage basin of 6,513 square miles in drainage area with a mix of overlapping stressors and sources in a mosaic of urban, suburban, and agricultural land uses in and around the greater Columbus metropolitan area. The 2022 assessment is a follow-up to previous full surveys of the Central Scioto River performed by MBI in 2015 and 2020, seven (7) major surveys by Ohio EPA between 1979 and 2010, and 23 fish surveys by Ohio EPA during 1979-2012 and MBI in 2015, 2020, and 2022.

Scope of the 2022 Scioto and Olentangy Rivers Biological and Water Quality Assessment

The scope of the 2022 biological and water quality assessment included the Scioto River mainstem between Griggs Dam in Columbus to Canal Park in Circleville, the Olentangy River mainstem from Powell Rd. to the mouth in downtown Columbus, and nine (9) Olentangy River tributaries in Columbus, one of which is part of Blueprint Columbus. The overall objectives of the 2022 survey included:

1. Evaluate the appropriateness of existing aquatic life use designations and make recommendations for any changes to those designations;
2. Determine the aquatic life status of streams and rivers in quantitative terms including the spatial extent and severity of impairments and their respective departures from established criteria;
3. Identify new or emerging threats to reaches of full attainment;
4. Determine the effectiveness of improvements resulting from the OARS project in the Scioto and Olentangy River mainstems;
5. Provide an assessment of potential nutrient enrichment effects using the large rivers nutrient assessment approach developed by Ohio EPA (Miltner 2018);
6. Provide baseline data for the assessment of Blueprint Columbus in the Olentangy River and Adena Brook;
7. Determine the effects of dam removals (thus far) and ascertain the effects of remaining dams;
8. Provide updated data for the assessment of Olentangy River tributaries last done by Ohio EPA in 1999 and 2003 in relation to sanitary sewer overflows (SSOs), MS4 stormwater permitting, and issues of interest to local stakeholders; and,
9. Evaluate the 2022 results against the most recent survey conducted by MBI in 2020.

The data presented herein were processed, evaluated, and synthesized as a biological and water quality assessment of aquatic life and recreational use attainment status. The 2022 bioassessment is directly comparable to previous assessments accomplished by Ohio EPA and MBI such that trends in status can be examined and causes and sources of impairment can be confirmed, appended, or removed. A more comprehensive assessment of long term trends is available in the 2020 report that documented changes over 50+ years (MBI 2022).

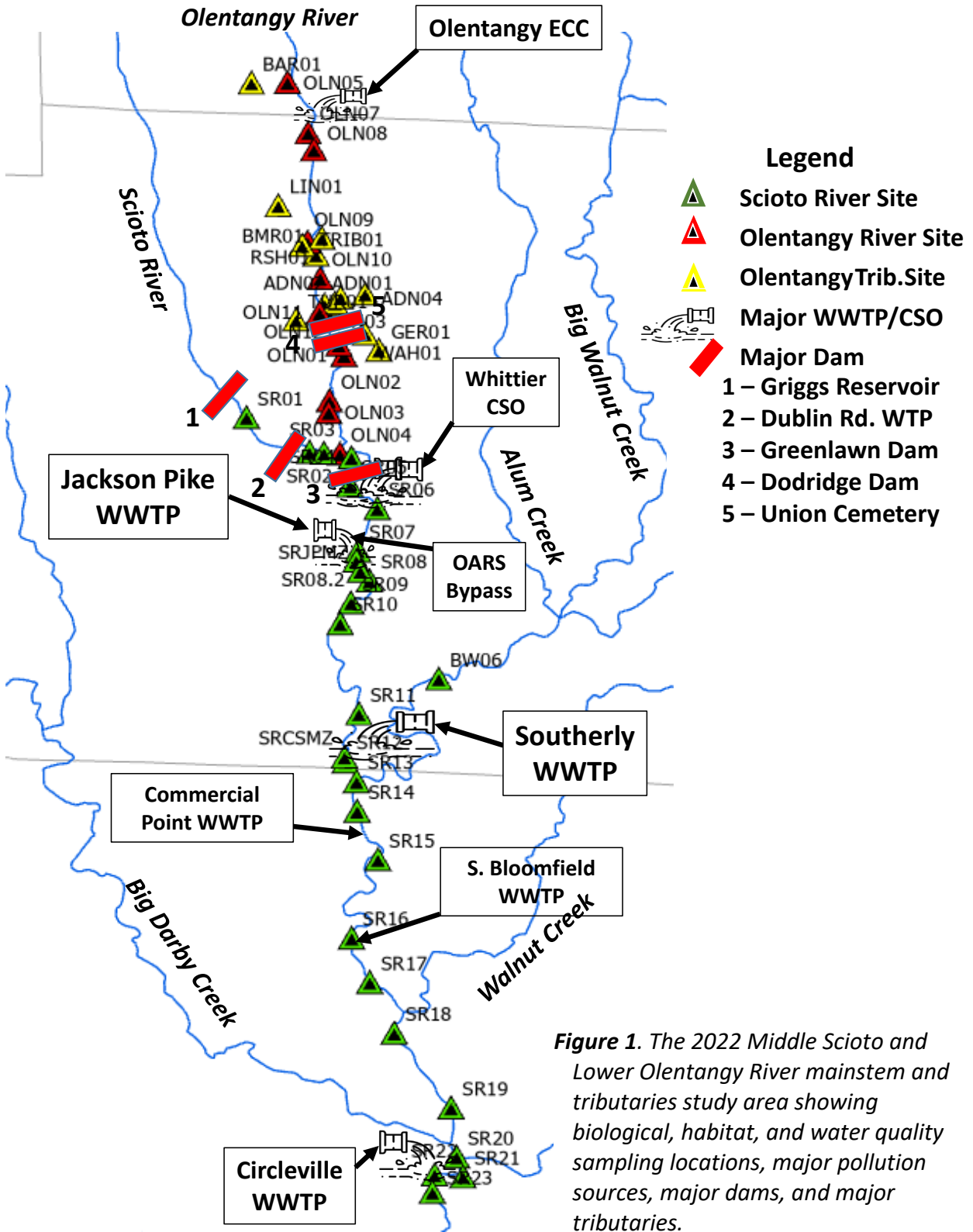
The 2022 bioassessment was conducted under a Level 3 Project Study Plan (PSP) submitted to and approved by the Ohio Credible Data Program. As such the results of the biological and habitat assessment can be used for purposes specified by the Ohio Credible Data Law and Regulations¹. Each monitoring site was sampled for biological assemblages (fish and macroinvertebrates), habitat (QHEI), and water quality (grab samples), with a selection of mainstem sites sampled for a suite of nutrient effect indicators (continuous and grab samples), and sediment chemistry for a total of 46 ambient and two mixing zone sites (Figure 1) as follows:

- The Scioto River mainstem had a total of 25 ambient and two mixing zone sites between Griggs Dam in Columbus and Canal Park in Circleville including a single site in Big Walnut Creek in Lockbourne;
- The Olentangy mainstem had 11 sites between Powell Rd. in southern Delaware Co. and the mouth in downtown Columbus.
- The Olentangy Tributaries had 12 sites including four in Adena Brook and one site each in Bartholomew Run, Rush Run, Bill Moose Run, Linworth Run, Turkey Run, Wahalla Hollow, Glen Echo Ravine, and an unnamed tributary (Olentangy RM 8.45).

Report Organization

The report is organized by the two distinct river mainstem reaches and tributary subwatersheds for the 2022 study area – the Scioto River mainstem, the Olentangy River mainstem, and the Olentangy Tributaries. With the exception of portions of the Summary and Conclusions, Introduction, Methods, and Study Area, each Results and Discussion section of the report is written as a stand-alone reporting of the results, thus some portions are redundant between the three major sections.

¹ Ohio Revised Code 6111.5 and Ohio Administrative Code 3745-4.



SUMMARY AND CONCLUSIONS

Overview of the 2022 DOSD Sponsored Monitoring and Assessment Program

The DOSD sponsored biological and water quality assessment of the Olentangy and Scioto Rivers took place during June-October 2022. It included 24 sites on the Scioto River mainstem between Griggs Dam in Columbus to Canal Park just below Circleville, a single site on Big Walnut Creek, 11 sites on the Olentangy River mainstem in Delaware and Franklin Counties, and 12 sites located across nine (9) Olentangy River tributaries. Adena Brook is directly related to Blueprint Columbus with all others related to MS4 stormwater permitting and local interests. Sampling was conducted for water chemistry, sediment chemistry, habitat, and biological assemblages. Chemical analyses were conducted for 26 laboratory analytes and four field parameters in water and seven (7) heavy metals and multiple organic chemical compounds in sediments in the Scioto and Olentangy River mainstems and at the mouth of each Olentangy River tributary. *E. coli* bacteria counts were determined to assess the status of the Primary Contact Recreational (PCR) use, but was also used as an indicator of organic pollution. Parameters consistent with a proposed Ohio EPA nutrient effects assessment methodology were also collected including two forms of chlorophyll a and continuous dissolved oxygen (D.O.), temperature, pH, and conductivity in the Scioto and Olentangy River mainstems. Four Datasonde locations were operated near continuously between early June to the end of October. Habitat quality was assessed with the Qualitative Habitat Evaluation Index (QHEI) and the biological assemblages included fish and macroinvertebrates consistent with Ohio EPA methods and the biological criteria for assessing the status of aquatic life use designations per the Ohio WQS (OAC 3745-1-07) at all sites.

The 2022 biological and water quality assessment was focused on the following issues of importance to DOSD and other stakeholders:

1. Documentation of the current status of aquatic life uses in the Scioto and Olentangy River mainstems and the Olentangy River tributaries. All of the previous use designation recommendations in 2015 and 2020 that were adopted by Ohio EPA in 2022 were verified in 2022.
2. Identification of chemical/physical or habitat related stressors associated with observed aquatic life use impairments or threats to existing full attainment with specific comparisons to the 2020 results in the Scioto and Olentangy River mainstems and Ohio EPA 1999 and 2003 results for the Olentangy River tributaries.
3. Assessment of nutrient impacts using the Ohio EPA large river nutrient criteria that consists of a multiparameter, "combined" approach that focuses on nutrient effects.
4. Documentation of the current status of recreational uses based on *E. coli* bacteria levels and adhering to the *E. coli* criteria in the Ohio WQS (OAC 3745-1-37[C]).

Aquatic Life Use Attainment Status

The principal goal of the 2022 biological and water quality assessment was to assess the status of the fish and macroinvertebrate assemblages that are the principal determinant of aquatic life

use attainment status. This was also done as an extension of consistent tracking of aquatic life status for the Scioto River during 1979-2012 by Ohio EPA and in 2007, 2015, and 2020 by MBI. Surveys of the Olentangy River and tributaries by Ohio EPA have been less frequent than the Scioto, but date back to 1987 with the most comprehensive surveys in 1999 and 2003. The datasets were comprehensively analyzed by MBI (2022) and detailed in recent publications (Yoder et al. 2019), the Ohio Water Environment Association (OWEA) Buckeye Bulletin and Columbus Monthly articles, and in presentations made to the OWEA, the Water Management Association of Ohio (WMAO), Friends of the Lower Olentangy Watershed (FLOW), and DOSD.

Scioto River Mainstem Summary of Results

Aquatic Life Use Attainment Status

The status of aquatic life use attainment in the Scioto River mainstem was determined using the 2022 fish and macroinvertebrate assemblage results and the biological criteria in the Ohio WQS (Table 1.) The 2022 results showed the continued attainment of the Exceptional Warmwater Habitat (EWH) use that was first observed in 2015 and again in 2020 downstream from Big Walnut Creek. This reaffirms that the current level of wastewater management continues to maintain this high level of quality. Attainment of the current WWH use was full at all sites sampled in the mainstem between Griggs Dam and Big Walnut Creek excepting at three (3) sites. The site within the Greenlawn Dam impoundment failed to meet the MWH-I use biocriteria due to the very poor performance of the macroinvertebrate assemblage. Macroinvertebrate impairment at this location was the most limiting factor as was previously observed in 2015 and 2020 due to the modified flow, impounded habitat, and excessive nutrient enrichment that is exacerbated by the hydrological and habitat modifications. Partial attainment of WWH was observed at SR08.2 (RM 127.25) due a fair IBI score of 36 that was seven (7) points below the 2020 value of 43. The MIwb and ICI scores were identical to the 2020 values. This site is located immediately downstream from the OARS bypass structure, but there was no indication of any significant changes in the frequency or volume of bypasses between 2020 and 2022. Partial attainment was also observed at SR09 (RM 125.3) downstream from Shelly Materials due the IBI score of 36 which was 4 points lower than in 2020. There were periodic discharges consisting of very high loadings of suspended sediment laden quarry wash water in the summer months of 2022, with one event precluding fish sampling due to excessively high turbidity levels. Both SR08.2 and SR09 were in full attainment of WWH in 2020. The 2022 results are minor departures and likely represent temporal impairments especially as evidenced by IBI scores of 40 (insignificant departure from the IBI biocriterion of 42) during the second sampling passes in the early fall. Ohio EPA sampled the Scioto River at 10 sites in 2021 as part of the statewide large rivers survey (Ohio EPA 2023). The single site sampled by Ohio EPA downstream from Griggs Dam was in partial attainment due to an ICI score of 28, which disagrees with the full attainment documented by the 2020 and 2022 MBI/DOSD surveys. Ohio EPA (2023) extrapolated their observed impairment downstream to the Olentangy River confluence. However, the 2020 and 2022 MBI/DOSD survey measured full attainment at three sites that were not sampled by Ohio EPA in 2021, underscoring the erroneous assignment of impairment to nearly 5 miles of the mainstem. A single site sampled by Ohio EPA (2023a) in 2021 also depicted aberrant results when compared to the more comprehensive assessments

Table 1. Status of aquatic life use attainment at 25 ambient sites in the Scioto River mainstem and Big Walnut Creek during July-October, 2022 based on existing and recommended uses (mixing zone sites are not assessed). The Ohio biocriteria appear in lower right corner. Biological index results in non-significant departure are in lighter shaded colors; non-attaining scores are shaded in accordance with legend at bottom.

Site ID	River Mile Fish/Macroinvertebrates	Drainage Area (mi. ²)	Current Aquatic Life Use ^a	IBI ^b	MIwb ^b	ICI ^b	Aquatic Life Use Status ^c	QHEI	Location	Comments			
Scioto River - WWH (Existing)													
SR01	136.05/136.20	1050	WWH	46	9.6	Good	FULL	88.0	Dst. 5th Ave.	Dst. Griggs Reservoir; ICI improved over 2020			
SR02	133.40/133.40	1070	WWH	44	9.6	MG ^{ns}	FULL	84.0	dst. Dublin Rd Dam	Flow affected by WTP water withdrawals			
SR03	133.00/132.80	1070	WWH	52	9.6	34 ^{ns}	FULL	87.0	dst. I-670	Flow affected by WTP water withdrawals			
SR04	132.10/132.10	1610	WWH	42	8.7	40	FULL	68.5	dst. Olentangy River	Recovering from impounded conditions			
Scioto River - Greenlawn Dam Pool - MWH-I (Existing)													
SR05	130.40/130.10	1620	MWH-I	36	8.4	6*	NON-VP	57.0	ust. Greenlawn Dam	Impoundment exacerbates nutrient, sediment effects			
Scioto River - Dst. Greenlawn Dam - WWH (Existing)													
SR06	129.23/129.00	1620	WWH	47	9.9	Good	FULL	86.3	dst. Greenlawn Ave.	Dst. Former Whittier CSO & storm tanks			
SR07	127.60/127.70	1620	WWH	49	10.6	42	FULL	85.5	dst. St. Rte. 104	Jackson Pike effluent recirculates ust. under low flows			
SR08.2	127.25/127.40	1620	WWH	36*	9.3	34 ^{ns}	PARTIAL	62.0	ust. Jackson Pike WWTP	Dst. OARS overflow structure			
SRJPMZ	127.00/127.00	1620	WWH	26	7.9	10	IMZ	NA	Jackson Pike WWTP mixing zone	Inside mixing zone (IMZ) site (biocriteria do not apply)			
SR08	126.40/126.50	1630	WWH	44	9.8	40	FULL	85.0	dst. Jackson Pike WWTP	First ambient site outside WWTP mixing zone			
SR09	125.05/125.40	1640	WWH	36*	8.9	40	PARTIAL	61.5	dst. American Aggregates	High sediment loading (turbidity) during first fish pass			
SR10	124.20/124.50	1670	WWH	50	10.0	40	FULL	80.3	dst. I-270				
SR11	119.90/120.10	1700	WWH	48	10.5	50	FULL	86.0	at SR 665				
SRCSMZ	118.20/118.20	1710	WWH	28	7.6	8	IMZ	NA	Southerly WWTP mixing zone	Inside mixing zone (IMZ) site (biocriteria do not apply)			
SR12	117.80/118.00	1710	WWH	47	10.2	44	FULL	72.5	dst. Southerly WWTP	First ambient site outside WWTP mixing zone			
Scioto River - Dst. Big Walnut Creek - EWH (Existing)													
SR13	117.15/116.90	2260	EWH	50	10.5	48	FULL	84.0	dst. Big Walnut Creek				
SR14	116.00/116.00	2270	EWH	49	10.7	52	FULL	86.5	dst. historic Pickaway Power Plant lot				
SR15	114.00/115.00	2280	EWH	48	10.3	52	FULL	84.5	dst. SR. 762	Dst. Commercial Point WWTP			
SR16	109.35/109.20	2310	EWH	50	10.5	54	FULL	84.0	dst. OH-316	Along bank opposite S. Bloomfield WWTP			
SR17	107.50/108.50	2320	EWH	48	10.2	42	FULL	77.0	ust. Walnut Creek				
SR18	105.25/106.00	2610	EWH	48	9.6	56	FULL	79.8	dst. Walnut Creek				
SR19	102.00/102.00	2640	EWH	49	9.8	50	FULL	81.5	dst. Commercial Point Rd.				
SR20	100.24/100.10	3200	EWH	50	9.5 ^{ns}	54	FULL	93.5	Circleville Riffle_ust. US 22	Dst. Hargus Creek			
SR21	99.52/99.40	3220	EWH	48	9.5 ^{ns}	52	FULL	89.8	ust. Circleville WWTP				
SR22	98.65/99.10	3220	EWH	46 ^{ns}	9.3 ^{ns}	46	FULL	74.5	dst. Circleville WWTP	Dst. Circleville WWTP			
SR23	98.01/97.90	3220	EWH	51	10.0	50	FULL	92.5	dst. Wicket Dam at Canal Park				
Big Walnut Creek - EWH (Existing)													
BW06	9.65/9.60	540.00	EWH	49	10.8	46	FULL	83.5	Lockbourne Rd. at Hamilton Twp. Park				
	Narrative Threshold Rankings	Exceptional		48-60	≥9.1	≥42	FULL	>75	Biological Criteria: Eastern Corn Belt Plains (ECBP)				
		Good		38-43	8.0-9.0	32-40	FULL	60-74	Index		WWH	EWH	MWH
		Fair		26-37	5.8-7.9	14-30	PARTIAL	46-59	IBI - Boatable		42	48	24.0
		Poor		19-25	4.0-5.7	8-12	NON-POOR	30-45	MIwb - Boatable		8.5	10	5.8
		Very Poor		12-18	<4.0	0-6	NON-V.POOR	<30	ICI - all sites		36	48	22.0
Footnotes: ^a - as codified in OAC 3745-1-07, Table 7-1; ^b - Nonsignificant departure of 4 units for IBI and ICI, 0.5 MIwb units allowed for attainment; ^c - FULL - all biocriteria attain; PARTIAL - one or two biocriteria fail to attain; NON - no biocriteria attain or one assemblage with poor or very poor narrative.													

by MBI/DOSD in 2020 and 2022. The 2020 and 2022 also conflict with the status of the mainstem reported in the Middle Scioto River TMDL report (Ohio EPA 2023b), but this was based on the 2012 survey which is not only 10 years before the 2022 survey, it did not include the recent upgrades to use designations in the Scioto River mainstem due to the removal of the Main Street Dam and the EWH designated reach downstream from Big Walnut Creek. It also missed the impairment in the Greenlawn Dam impoundment reported by the 2020 and 2022 MBI/DOSD bioassessments.

While all of the mainstem except for the Greenlawn Dam impoundment and two isolated instances of partial attainment at SR08.2 (RM 127.7) and SR09 (RM 125.5) in 2022, the attainment status has been consistently full at all other sites since 2015. Still, distinct reaches with evidence of stresses that constitute varying levels of potential threat include:

1. The Greenlawn Dam impoundment remains chronically impaired for the MWH use, a repeat of the same result in 2020. The principal causes are the altered habitat and altered flow regime with each exacerbating the effect of nutrient over-enrichment on the D.O. regime. The ideal solution to this impairment is removing the Greenlawn Dam itself. However, this option has been considered and is economically impractical at present. A TMDL with the dam remaining would most likely result in substantial and perhaps unattainable reductions in nonpoint source loadings of both urban and agricultural origin. The altered flow regime is a contributing factor, the restoration of which also seems unlikely given the existing demands for drinking water via the Dublin Rd. WTP and recreation pool maintenance in the Delaware Reservoir, each of which affects summer-fall low flows in the Scioto River in the impoundment. The current Loading Analysis Plan (Ohio EPA 2023) did not identify this site as impaired based on data collected by Ohio EPA in 2010 (Ohio EPA 2012).
2. The reach between Griggs Reservoir and the Olentangy River confluence while attaining WWH, has exhibited marginal attainment of the macroinvertebrate assemblage in particular and with symptoms of marginal D.O., indications of nutrient over-enrichment in high D.O. levels and wide diel swings, elevated DELTs, and exceedances of the Probable Effect Concentration/Severe Effect Level (PEC/SEL) thresholds for PAH compounds. This is indicative of a mix of enrichment inputs from the Griggs Reservoir, urban runoff, and the indirect effects of flow alterations.
3. The general reaches between Greenlawn Dam to I-270S in 2020 and to the Southerly WWTP in 2022 attained WWH, but exhibited several indicators of stress including reduced Mayfly abundance, elevated DELT anomalies, and a few sites with elevated organic tolerant taxa. There were no indications of D.O. exceedances, but exceedances of the PEC/SEL thresholds for PAH compounds were observed. The distance of these effects downstream expanded in 2022 compared to 2020 when it was restricted to I-270S. The Greenlawn Dam appears to be a major source of enrichment and it was more severely impaired in 2022 than in 2020, extending the urban footprint further downstream in 2022 than in 2020.
4. The reach downstream from the Southerly WWTP downstream to Circleville attained EWH, but exhibited more indications of stress in 2022 than in 2020, with reduced Mayfly abundance and moderately elevated DELTs on fish. There were no chemical indicators of stress other than a few elevated maximum D.O. values which reached levels comparable to

the Greenlawn Dam impoundment at the two sites downstream from Circleville.

5. The site downstream from Walnut Creek exhibited subtle indications of stress including elevated DELTs, reduced Mayfly abundance, and high proportions of Gizzard Shad, which in 2020 caused the IBI to perform less than the EWH biocriterion. This merits further investigation via a future TMDL as it seems to threaten the current EWH attainment.

Trajectories in Key Indicators – Scioto River Below Greenlawn Dam

Knowing the temporal trajectory of the indicators and parameters that are provided by a spatially adequate monitoring design is important feedback to Columbus DOSD, Ohio EPA, and stakeholders in the Middle Scioto and Olentangy River study area. The 2022 study area has a complex mosaic of watershed level and site-specific impacts the complexity of which makes being able to understand and then develop management responses to both restoring impairments and preserving high quality an immense challenge. The documentation of incremental improvements allows program effectiveness to be counted as credit even when it falls short of achieving full restoration. Furthermore, failing to recognize if waters are improving and on positive trajectory can lead to erroneous conclusions about the attainability of Clean Water Act (CWA) goals and the viability of restoration efforts. Simply put, a selective focus on individual and selected pollutants is insufficient in a complex setting like the 2022 study area. It is for these reasons that being able to detect, measure, and express incremental improvements in key indicators is vital. Showing incremental progress not only provides confirmation that restoration efforts are working, it also provides important feedback for those programs which, because of uncertainties about their eventual success, must be adaptive in order to succeed. As such, the type of monitoring and assessment that was employed in this survey was designed to provide results that could be used to demonstrate the degree and direction of incremental change and support an adaptive management approach.

Trends in Scioto River Mainstem Area of Degradation and Attainment Values

The Area of Degradation (ADV; Yoder and Rankin 1995b) was developed to quantify the extent and severity of departures below a biocriterion on a river reach scale. Performance above the biocriterion is expressed as the Area of Attainment Value (AAV) which quantifies the extent to which use attainment biocriteria are surpassed (Yoder et al. 2005). The ADV/AAV correspond to the area of the polygon formed by the longitudinal profile of the IBI, MIwb, or ICI scores over a reach of stream or river and the horizontal line boundary formed by the applicable biocriterion, the AAV above and the ADV below. The historical dataset spanning 1974-2022 was used to quantify the degree to which aquatic life has changed through time up to and including the 2022 survey. This includes Ohio EPA surveys of 1974-2012 and the 2007, 2015, 2020, and 2022 MBI surveys of the mainstem. As such it is a quantification of the “totality” of biological impairment and attainment over a reach of a river. When normalized to a standard distance (e.g., per mile) it is an effective indicator of the degree of change that has taken place through time between years or between rivers and streams. The historical database of consistently collected fish and macroinvertebrate assemblage data in the Scioto River mainstem in and below Columbus is the most complete for any river in the Midwestern U.S. Spatially sufficient macroinvertebrate data is available for 16 years over the period 1974-2022 and fish data is

available for 39 years over the period 1979-2022 (Figure 2). Each of the three biological assemblage indices show improvement from very high ADV and zero AAV values in the 1970s and 1980s, to zero ADV and increased AAV values through the latter half of the four decade record of data beginning in 1991 and through 2022. The incremental shift from very high ADV values to zero coupled with increasingly higher AAV values occurred incrementally and in response to major wastewater treatment upgrades that initiated with the significant reduction in the dry weather bypassing of raw sewage at the Southerly WWTP in the early 1980s that resulted from the composting of sewage sludge. The MIwb responded more quickly than did the IBI or the ICI which owes to its basis in numbers and biomass of fish, and while it excludes highly tolerant species, it retains moderately tolerant and facultative species that tolerate moderate amounts of organic pollution. The MIwb ADV was nearly eliminated after the sludge composting came on line with a solid string of AAV values only after 1990. The IBI, being more broadly representative of the intolerant and functional trait components of the fish assemblage, responded later with ADV values being eliminated only after all dry weather bypassing was eliminated in 1989-90. By 2011 the IBI AAVs were consistently higher with zero ADVs, the zenith of which occurred some 22 years after the installation of advanced wastewater treatment (AWT) via Project 88. The macroinvertebrate assemblage responded more slowly than did the fish and is due to non-attainment that persisted downstream from the Whittier Street CSO and also downstream from the Jackson Pike WWTP as recently as 2009 and 2010. The 2015, 2020, and 2022 results showed the complete elimination of ADVs and consistently higher AAVs signifying a more robust and complete recovery 26 years after Project 88. The completion of the OARS Phase I project in 2015 was a likely contributor to the improved performance of the macroinvertebrate assemblage between Greenlawn Dam to I-270 downstream from the Jackson Pike WWTP in 2015, which was the final piece of full recovery. Still, detectable symptoms of an urban “footprint” in some of the chemical and biological indicators extended from Griggs Dam downstream to I-270S in 2020 and to Southerly in 2022. These specific instances are described in the 2020 report (MBI 2022) and in the 2022 results.

Scioto River Mainstem Recreational Use Assessment

Recreational use attainment was determined using *Escherichia coli* (*E. coli*) mean and maximum values that approximate the water quality criterion expressed as 90-day geometric mean and Statistical Threshold Value (STV) for the Primary Contact Recreational (PCR) use designation. The criteria are codified in OAC 3745-1-37(C) with 126 cfu/100 mL for the 90-day geometric mean and 410 cfu/100 mL for the STV, respectively. The Secondary Contact Recreational (SCR) use criterion of 1030 cfu/100 mL does not apply in the Scioto River mainstem. This amounts to a screening assessment using the mean and maximum values in lieu of true geometric mean and STVs at each site for the PCR use (Table 2). Six exceedances of the geometric mean occurred sporadically and with all values only 7-91 cfu/100 mL above the mean criterion and all except one occurring between SR04 (RM 132.1) to SR09 (RM 125.3) just downstream from I-270S. The mean in Big Walnut Creek was also a minor exceedance of the PCR mean. Only two exceedances of the STV occurred, one in Big Walnut Creek at BW06 (RM 9.6) and the other at SR20 (RM 99.9) in Circleville. By comparison, the 2020 results showed more frequent and severe exceedances of the PCR mean and STVs between SR02 (RM 133.4) downstream to Columbus Southerly at SR 12 (RM 118.0) with maximum values exceeding the Secondary

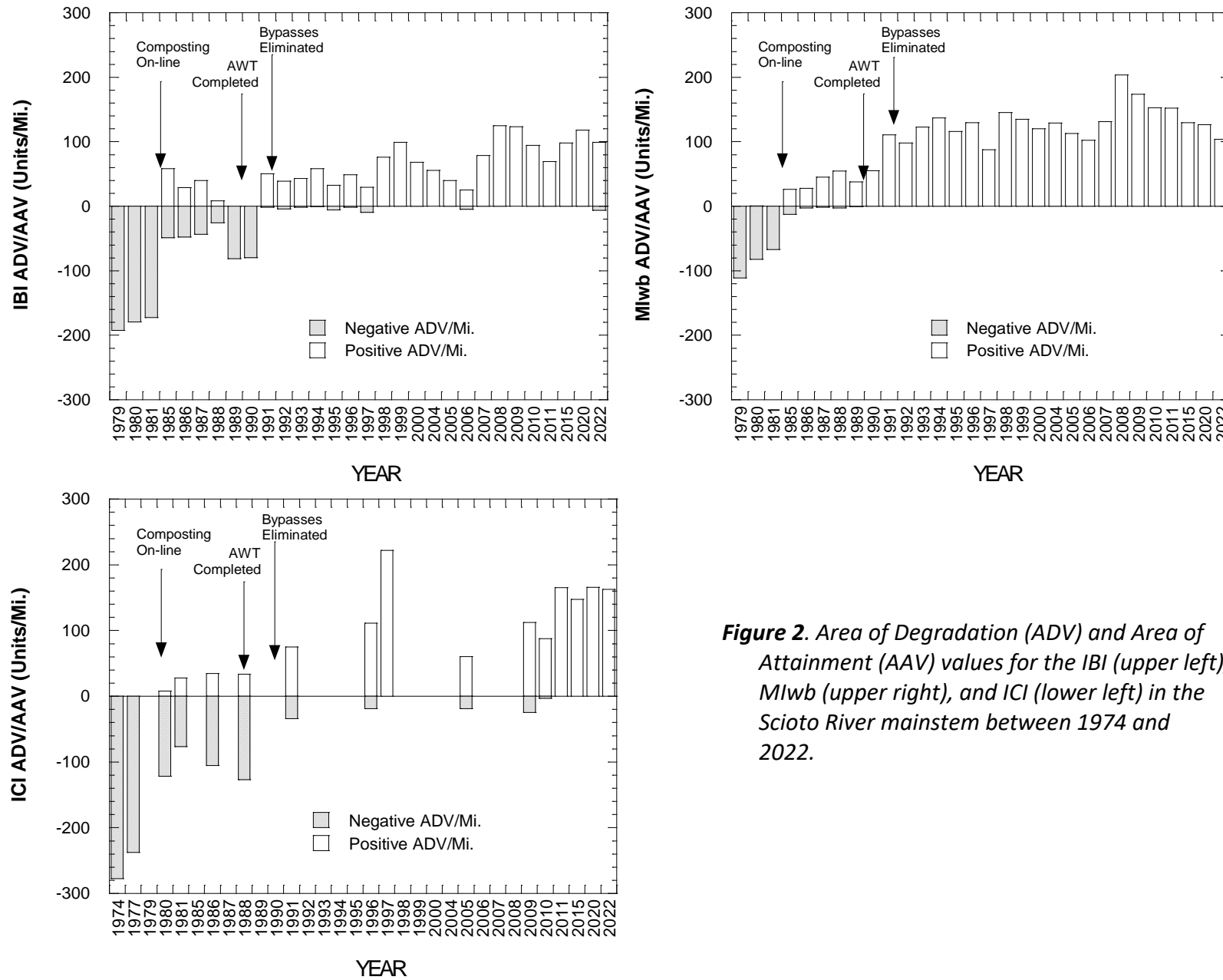


Figure 2. Area of Degradation (ADV) and Area of Attainment (AAV) values for the IBI (upper left), MIwb (upper right), and ICI (lower left) in the Scioto River mainstem between 1974 and 2022.

Contact Recreation (SCR) STV criterion at six (6) sites. Fecal bacteria indicators like *E. coli* are vulnerable to false positives from non-human sources and are predictably elevated in urbanized areas, but also in rural areas after periods of runoff. Extremely high values (e.g., >5,000 cfu/100 mL) are indicative of releases of untreated or poorly treated human sewage.

Table 2. *E. coli* values (cfu/100 mL) for samples collected in the Scioto River mainstem during June-October 2022. Yellow shaded values exceed the recommended 90-day geometric mean (126 cfu/100 mL) and orange shaded values exceed the maximum STV (410 cfu/100 mL) Primary Contact Recreation (PCR) use criteria and red shaded values exceed the Secondary Contact Recreation (SCR) use criterion.

Site ID	River Mile	Drainage Area (mi. ²)	Samples	Date of Minimum	Minimum	Mean	Maximum	Date of Maximum
Scioto River								
SR01	136.5	1050	6	July 26	20	50	360	Sept. 15
SR02	133.4	1050	6	Aug. 29	<10	34	63	Sept. 15
SR03	132.7	1070	6	Aug. 29	<10	43	63	Sept. 15
SR04	132.1	1610	6	Oct. 11	31	144	330	Sept. 29
SR05	129.9	1620	6	Oct. 11	10	49	230	Sept. 15
SR06	129.5	1620	5	Oct. 11	10	52	210	Sept. 15
SR07	127.7	1620	5	June 28	31	83	150	Sept. 13
SR08.2	127.4	1620	6	June 28	52	133	370	Aug. 31
SRJPMZ	127.0	1620	6	June 28	86	110	170	Sept. 13
SR08	126.2	1630	6	June 28	86	197	290	Aug. 31
SR09	125.3	1640	6	Oct. 17	110	181	240	Aug. 17
SR10	123.8	1670	6	Oct. 17	52	125	260	Aug. 31
SR11	120.1	1700	6	Oct. 12	47	108	340	June 29
SRCSMZ	118.2	1710	6	Oct. 12	10	77	150	Aug. 4
SR12	118.0	1710	6	Oct. 4/Oct. 12	52	118	200	Aug. 4
SR13	116.9	2260	6	Oct. 4	52	80	110	Sept. 14
SR14	116.0	2270	6	Oct. 4	52	97	180	June 29
SR15	114.4	2280	6	Oct. 12	74	130	300	Aug. 4
SR16	109.3	2310	6	June 30	46	77	340	Aug. 30
SR17	108.5	2320	6	June 30	73	103	150	Sept. 20
SR18	105.1	2610	6	Aug. 16	63	78	120	Sept. 28
SR19	102.1	2640	6	June 30	41	79	140	Sept. 28
SR20	99.9	3200	6	Sept. 28	1	55	590	Sept. 28
SR21	99.4	3220	6	Oct. 18	41	77	280	Aug. 30
SR22	98.7	3220	6	Oct. 18	31	102	360	Aug. 30
SR23	97.9	3220	6	Oct. 18	30	61	300	Aug. 30
Big Walnut Creek								
BW06	9.6	547	6	Oct. 12	64	190	700	June 23
	exceedance of Primary Contact Recreation (PCR) geometric mean criterion of 126 cfu/mL.							
	exceedance of PCR Statistical Maximum Value (STN) criterion of 410 cfu/mL.							
	exceedance of Secondary Contact Recreation (SCR) maximum criterion of 1030 cfu/mL.							

Olentangy River Mainstem and Tributaries Summary of Results

Aquatic Life Use (AQLU) Attainment Status

The status of aquatic life use attainment in the Olentangy River mainstem and tributaries was likewise determined using the 2022 fish and macroinvertebrate assemblage results and the biological criteria in the Ohio WQS (Table 3). The Lower Olentangy River 2020 and 2022 mainstem assessments are the first comprehensive assessment of the lower mainstem and tributaries since 2003 and 1999, although there have been surveys of partial reaches before and since that time including 1987, 1991, 2011 and 2015. The 2011 and 2015 surveys were limited to the lowest reach of the mainstem downstream from the Dodridge Street Dam and focused on “before and after” removal of the Fifth Avenue Dam in 2014.

Olentangy River Mainstem AQLU Status

Similar to 2020, the 2022 results were mixed with full attainment at the upstream most site (OLN05) and partial attainment at the next two sites in the EWH designated upper reach upstream from I-270N (OLN07 and OLN08) which is similar for the fish results, but a decline for the ICI at OLN08 from 2020. The IBIs met the EWH biocriterion at OLN07 and OLN08, but the MIwb failed to meet the EWH biocriterion by only 0.2 and 0.6 units, respectively. DELT anomalies were elevated at all five (5) mainstem sites exceeding the 3 metric scoring boundary over a distance of 7.9 miles. This was an increase in DELTs observed in 2020 that were mostly zero or less than the 5 metric score boundary of 0.5%. The ICI was in solid attainment of the EWH biocriterion at the upstream most two sites OLN05 and OLN07, but failed to meet it at the next site (OLN08). Full attainment of the WWH designated reach downstream was observed at the two sites between I-270N (OLN09) and Henderson Rd. (OLN10) where both fish indices met and surpassed the EWH biocriteria, but the ICI was in attainment of WWH and marginally so at OLN09. The status changed to partial attainment of MWH at OLN11 downstream from Adena Brook and adjacent to Northmoor Park where the ICI failed to meet the MWH biocriteria. This site is partially impounded by the North Broadway Dam, but it also coincides with *E. coli* exceedances in the mainstem, which can also serve as a sewage enrichment signature. DELT anomalies on fish were further elevated above the 1 metric scoring boundary of 1.3% for this IBI metric at all except one site between OLN10 and OLN03 a distance of 4.1 miles. This also contrast with the 2020 results that were mostly zero or less than the 5 metric score boundary of 0.5%. However, there was nothing in the chemical or nutrient assessment results that suggests a significant source of organic enrichment other than the *E. coli* exceedances. The site in the Dodridge Street Dam impoundment (OLN12) was in partial attainment of the Modified Warmwater Habitat (MWH-I) for impounded reaches use designation due the failure of the ICI to meet the applicable biocriterion. The site downstream from Dodridge Street was in full attainment of WWH with 10 of 12 index values meeting the EWH biocriteria. The current WWH designation was adopted in November 2022 and replaced MWH from Tuttle Park (RM 3.9) to the mouth. The removal of the Fifth Avenue Dam on the Olentangy River and the Main Street Dam on the Scioto River has restored free-flowing habitat such that all of the indices now easily meet and even exceed their WWH biocriteria and, with only two exceptions, meet the EWH biocriteria.

Table 3. Status of aquatic life use attainment at 11 sites in the Lower Olentangy River mainstem during July-October, 2022 based on existing and recommended uses. The Ohio biocriteria appear at the bottom center.

Site ID	River Mile Fish/Macroinvertebrates	Drainage Area (mi. ²)	Current Aquatic Life Use ^a	IBI ^b	MIwb ^b	ICI ^b	Aquatic Life Use Status ^c	QHEI	Location	Comments
Olentangy River - EWH (Existing)										
OLN05	14.90/14.40	482	EWH	48	9.9	E	FULL	78.0	dst. OH-750	Upstream "control" site
OLN07	12.90D/13.30	489	EWH	46 ^{ns}	8.9 ^{ns}	46	PARTIAL	76.5	dst. Olentangy WRF	Dst. Olentangy ECC discharge
OLN08	12.30D/11.90	490	EWH	46 ^{ns}	8.5 ^{ns}	38*	PARTIAL	79.0	ust. I-270	
Olentangy River - WWH (Existing)										
OLN09	8.50/8.50	510	WWH	50	9.3	34 ^{ns}	FULL	82.5	dst. Broad Meadows Dam	Located dst. dam in "artificial riffles"; dst. Rush Run
OLN10	7.10/7.00	516	WWH	50	9.4	38	FULL	82.5	ust. Henderson Rd.	Dst. Bill Moose Run
Olentangy River - MWH-Impounded (Existing)										
OLN11	5.82/5.50	524	MWH-I	32	7.3	20	FULL	54.5	ust. W. North Broadway, dst. Adena Brook	Partially impounded by N. Broadway Dam
OLN12	4.45/4.50	529	MWH-I	38	7.9	20	FULL	58.0	ust. Dodridge Dam, adj. OSU wetlands	Fully impounded by Dodridge Dam
Olentangy River - WWH (Existing)										
OLN01	3.95/3.90	531	WWH	48	10.2	VG	FULL	78.8	dst. Dodridge dam	
OLN02	2.00/2.00	537	WWH	48	9.9	42	FULL	75.0	dst. 5th. Ave.	Formerly impounded habitat in recovery
OLN03	1.80/1.70	537	WWH	48	10.4	38	FULL	85.3	dst. 5th. Ave., ust. 3rd. Ave.	
OLN04	0.20D/0.60	543	WWH	52	8.9	42	FULL	78.5	ust. I-670 bridge	
Narrative Threshold Rankings	Exceptional			48-60	>9.1	>42	FULL	>75	Biological Criteria: Eastern Corn Belt Plains (ECBP)	
	Good			38-43	8.0-9.0	32-40	FULL	60-74		
	Fair			26-37	5.8-7.9	14-30	PARTIAL	46-59		
	Poor			19-25	4.0-5.7	8-12	NON-POOR	30-45		
	Very Poor			12-18	<4.0	0-6	NON-V.POOR	<30		
		Index	WWH	EWH	MWH					
		IBI - Wading	40	50	24					
		IBI - Boatable	42	48	24					
		MIwb - Wading	8.3	9.4	6.2					
		MIwb - Boatable	8.5	9.6	5.8					
		ICI - all sites	36	48	22					

Footnotes: ^a - as codified in OAC 3745-1-07, Table 7-1; ^b - Nonsignificant departure of 4 units for IBI and ICI, 0.5 MIwb units allowed for attainment; ^c - FULL - all biocriteria attain; PARTIAL - one or two biocriteria fail to attain; NON - no biocriteria attain or one assemblage with poor or very poor narrative; D - sampled with wading gear..

Trajectories in Key Indicators – Lower Olentangy River Mainstem

The historical dataset spanning 1987-2022 was used to quantify the degree to which overall aquatic life conditions have changed through time up to and including the 2020 survey. This includes the Ohio EPA surveys of 1987, 1989, 1999, 2003, 2004 and the 2020 and 2022 MBI surveys of the lower Olentangy River mainstem. The ADV/AAV is a quantification of the “totality” of biological attainment and impairment. When normalized to a standard distance (e.g., per mile) it is an effective indicator of the degree of change through time.

The results for each of the three indices show somewhat different trends for the 1987-2020 time period. The fish assemblage indices showed little change through this time period with very low or no ADVs and AAVs signifying a general performance above the WWH baseline (Figure 3). Unlike the Scioto River mainstem results that showed a strong response to loading reductions at the two Columbus WWTPs, the Olentangy River mainstem has never been subject to pollution loadings of that magnitude. The historical range of the dataset and its consistency through time is somewhat limited to being mostly after major WWTPs upgraded to advanced wastewater treatment. The only major source of wastewater in the study area, the Olentangy ECC, had advanced treatment from its start up in 1980 in order to protect the Olentangy River mainstem status as a State Scenic River. However, ECC flows and loadings of ammonia-N have increased over time corresponding to population growth in the area. The lower Olentangy River has remained in good to excellent condition through time as demonstrated by the consistency of the fish assemblage over time. The macroinvertebrate assemblage response has been less consistent with the highest ADVs occurring in 1999 and 2003, but recovering in 2004 and 2020 with low or zero ADVs and increased AAVs. The 2022 ICI AAV remained positive, but was about one-half of the 2020 AAV. Some of the positive response in both assemblages was due to the removal of the Fifth Ave. dam in the lower Olentangy and the Main Street dam in The Scioto which restored the riverine habitat throughout the lower 4 miles of the Olentangy mainstem. The remaining minimal ADVs are due to the brief reaches of partial attainment upstream from the Dodridge and North Broadway Dams.

Olentangy River Tributaries AQLU Status

Nine (9) tributaries were sampled along the lower 15 miles of the Olentangy River mainstem in 2022. All have relatively small watershed areas of general less than 2-3 square miles, are nestled in ravines, and are characteristically short in the trellised watershed of the Lower Olentangy River. Two (2), Rush Run and Adena Brook, were sampled in 2020 at four (4) sites each plus one site in Beechwold Run that was not sampled in 2022. The 2020 sampling in Adena Brook and Beechwold Run was focused on establishing a more comprehensive baseline for Blueprint Columbus and in Rush Run to clarify the impaired waters status and as a demonstration of small urban watershed assessment in support of the MS4 program. The results for both are detailed in the 2020 biological and water quality assessment report (MBI 2022). The number of tributaries was expanded in 2022 to include several that were last sampled in 1999 and 2003 by Ohio EPA. These seven (7) tributaries each had one site generally located within 0.5-2.0 miles from the mouth. Four (4) were previously sampled by Ohio EPA in 1999 and three (3) in 2003.

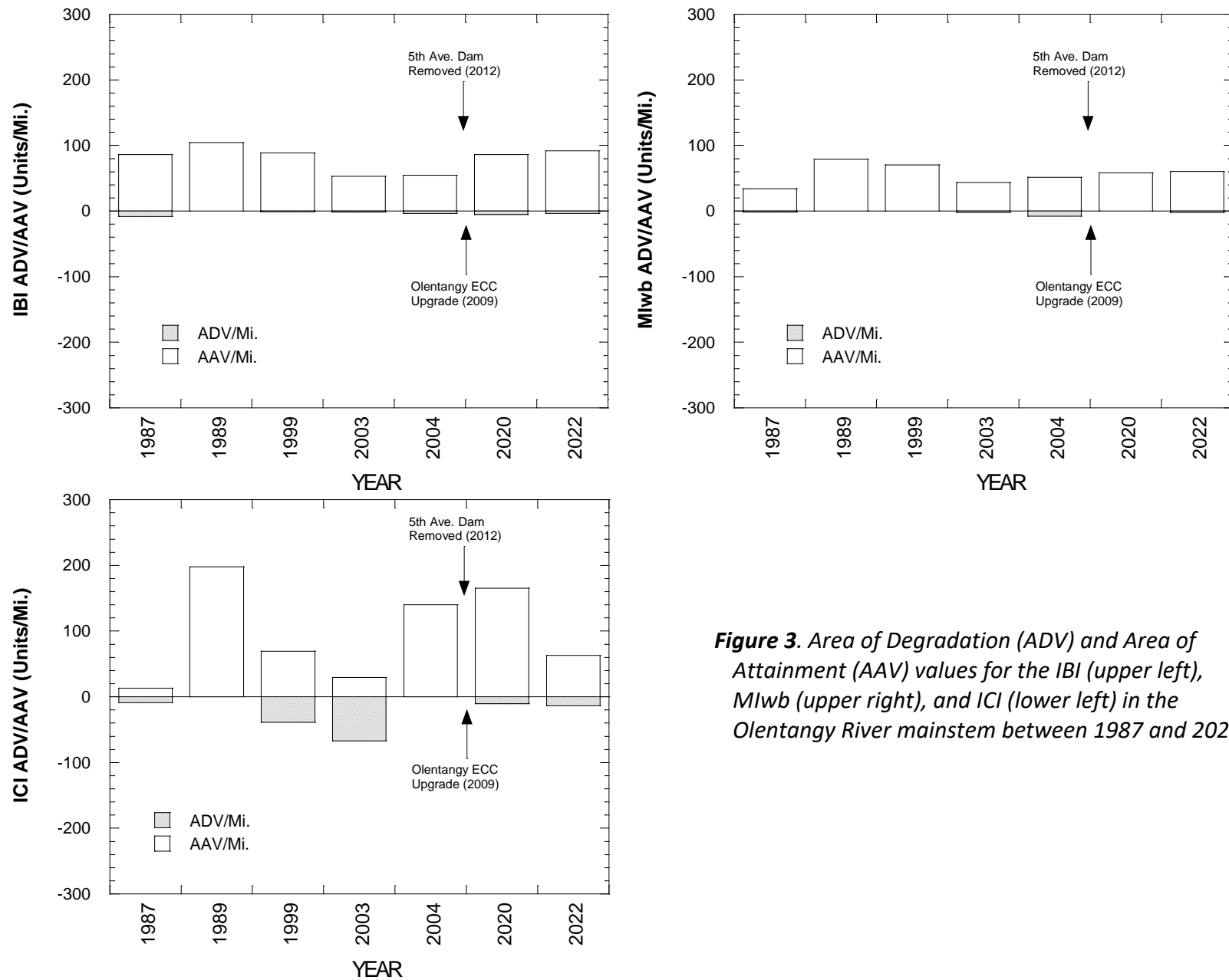


Figure 3. Area of Degradation (ADV) and Area of Attainment (AAV) values for the IBI (upper left), MIwb (upper right), and ICI (lower left) in the Olentangy River mainstem between 1987 and 2022.

The Unnamed Tributary at RM 8.45 is a new site. Each has varying intensities of urban/suburban land uses and the accompanying mosaic of water quality, hydrological, and habitat alterations that pose difficult restoration and protection challenges. The challenges to protecting and restoring water quality and habitat as outlined in the Watershed Action Plan by the Friends of the Lower Olentangy Watershed (FLOW 2003) remain today. Eight (8) of the nine (9) tributaries are designated WWH in the Ohio WQS (3745-1-09, Table 9-1). Out of the 12 sites assessed in 2022, two (2) were in partial attainment and 10 were in non-attainment due to poor IBI and/or macroinvertebrate narratives to marginally good IBI and fair macroinvertebrate narratives (Table 4). All of the tributaries had consistent detections of PAH compounds in sediment that exceeded the Probable Effect Concentration (PEC) or Severe Effect Levels (SEL). Sediment metal exceedances were rare, but were detected at all sites. In terms of water column parameters, total phosphorus was consistently greater than the 90th percentile of ECBP headwater reference values. Dissolved ions were sporadically elevated above the 90th and 95th percentiles for chlorides, total dissolved solids, and conductivity. Total suspended solids, which is a key indicator for MS4 programs, was well below the 75th percentile of ECBP headwater reference sites.

Adena Brook (RM 6.00) and Rush Run (RM 8.75)

The results in Adena Brook and at the mouth of Rush Run were similar to 2020 excepting the poor IBI score at ADN03 improved slightly to fair in 2022 and the good IBI score at ADN01 in 2020 declined to marginally good in 2022 with partial attainment of WWH in both years. The results at the mouth of Rush Run in 2022 had a poor macroinvertebrate narrative compared to fair in 2020, with non-attainment in both years even though the IBI improved slightly to marginally good in 2022. Such results are typical for small urban streams especially where the urban landscape and flow modifications have been long lasting and are essentially permanent. The 2020 and 2022 datasets provide a more complete baseline against which to evaluate the effectiveness of Blueprint Columbus on Adena Brook and the Olentangy River mainstem. The 2020 and 2022 biological results showing mostly non-attainment of the WWH aquatic life use has been observed during previous and more limited surveys of Adena Brook, Rush Run, and other tributaries with CSO and SSO outfalls in the 1990s and early 2000s, although the 2020 results generally showed improved conditions over the results obtained at the mouth of both streams in 1999, particularly for Adena Brook which had poor fish and macroinvertebrate assemblages. Several chemical parameters including chlorides, total dissolved solids, conductivity, and zinc remained elevated at ADN02 which is downstream of multiple past releases. Adena Brook has been subject to frequent spills and unauthorized pollution releases including a fish kill in 1993, a ruptured sewer line in 1996, and 4500 gallons of vinegar discharged in the very headwaters from the Marzetti food processing company in 2001 (Ohio EPA 2001, 2005). A tributary to Adena Brook had a fish kill reported in 1999, though no source for the kill could be determined. MBI documented evidence of spills at ADN01 in 2020 (MBI 2022). These events are reinforced by the observations of local residents and documentation by Ohio EPA (2001, 2005) and FLOW (2003). Such spills and releases are likely more frequent than what is being formally reported. This is a common characteristic of small urban watersheds and part of the “urban stream syndrome” (Walsh et al. 2005). Based on the results of a recently released national study of urban stormwater by USGS (Bradley et al. 2023), the actual number

Table 4. Status of aquatic life use attainment at 10 sites in three Lower Olentangy River tributaries (Adena Brook, Beechwold Run, and Rush Run) during July-October, 2022 based on existing and recommended uses. The Ohio biocriteria appear in the lower right corner.

Site ID	River Mile Fish/Macroinvertebrates	Drainage Area (mi. ²)	Current Aquatic Life Use ^a	IBI ^b	Qual. Narrative ^b	Aquatic Life Use Status ^c	QHEI	Location	Comments		
Bartholomew Run (RM 14.48)											
BAR01	0.20/0.20	0.70	WWH	32*	P*	NON	63.5	Bennet Rd.	Stormwater from Powell east side		
Linworth Run (RM 9.99)											
LIN01	0.80/0.90	0.90	WWH	26*	F*	NON	63.0	Linworth Rd.	Stormwater from Smoky Row area		
Rush Run (RM 8.75) - WWH (Existing)											
RSH05	0.24/0.20	2.62	WWH	36 ^{ns}	P*	NON	72.0	Ust. mouth in Rush Run Park	Rush Run Park in Riverlea		
Tributary to Olentangy River (RM 8.45)											
TRIB01	0.20/0.10	0.10	WWH	30*	F*	NON	65.5	Behind 5530 Olentangy River Rd.	Residential development on ravine bluffs		
Tributary to Olentangy River (RM7.82) (Bill Moose Run)											
BMR01	0.20/0.20	0.20	WWH	40	F*	PARTIAL	70.5	Kenny Park			
Adena Brook - WWH (Existing)											
ADN04	1.70/1.60	1.80	WWH	26*	P*	NON	76.0	Intersection Overbrook/Yaronia Dr. - ust. control site	Ust. Project Blueprint monitoring site		
ADN03	0.80/0.90	2.26	WWH	22*	F*	NON	60.5	Dst. Overbrook Dr. adj. Canyon Drive - dst. Storm sewer	Dst. Project Blueprint monitoring site		
ADN02	0.52/0.70	2.56	WWH	28*	F*	NON	57.3	Dst. N. High Street - dst. storm sewer outfall	Dst. suspected spill source		
ADN01	0.23/0.20	2.71	WWH	36 ^{ns}	F*	PARTIAL	75.5	Park of Roses - ust. storm sewer locations	Ust. Project Blueprint lower monitoring sites		
Turkey Run (RM 5.82)											
TUR01	0.70/0.70	2.30	WWH	24*	P*	NON	69.5	Shattuck Rd.	Mixed urban development		
Wahalla Hollow (RM 4.58)											
WAH01	1.00/0.40	0.40	Undesig.	12*	P*	NON	47.0	Adj. Wahalla Rd.	Heavy urban land use		
Glen Echo Ravine (RM 4.10)											
GER01	0.95/1.00	0.50	WWH	12*	P*	NON	57.0	Glen Echo Park	Heavy urban land use		
Narrative Threshold Rankings	Exceptional		WWH	46-60	E	FULL	>75	Biological Criteria: Eastern Corn Belt Plains (ECBP)			
	Good		WWH	36-45	G	FULL	60-74	Index	WWH	EWH	MWH
	Fair		WWH	26-35	F	PART./NON	46-59	IBI - Headwater	40	50	24
	Poor		WWH	19-25	P	NON-Poor	30-45	ICI - Narrative	G	E	F
	Very Poor		WWH	12-18	VP	NON-V,Poor	<30	ICI - all sites	36	48	22
ICI Narratives: E - Exceptional; G - Good; F - Fair; P - Poor; VP - Very Poor											
Footnotes: ^a Biocriteria codified in OAC 3745-1-07, Table 7-1; ^b Narrative assessment used in lieu of ICI; ^c FULL - all biocriteria attain; PARTIAL - one/two biocriteria fail attain; NON - no biocriteria attain or one assemblage poor/very poor narrative.											

of urban pollutants present is likely being significantly undercounted in this study and is part of the mosaic of stressors that result in almost uniform aquatic life impairment.

Bartholomew Run (RM 14.48)

This northernmost tributary in the 2022 Lower Olentangy study area enters from the west and drains to the eastern portion of Powell. The sampling site at RM 0.20 was in non-attainment of WWH due to a poor macroinvertebrate narrative and an IBI of 32. The QHEI of 63.5 was good ruling out habitat as a cause of the impairment. Nutrient, demand, and ionic strength parameters in the water column were consistent with suburban development. Sediment chemistry data indicated low level exceedances for 3 metals (arsenic, nickel, and lead) and a single PAH probable effect exceedance for fluoranthene. Ohio EPA (2001) documented impairment based on a fair macroinvertebrate assessment and assigned causes related to a developing watershed including bank erosions and sedimentation. The elevated *E. coli* levels that are discussed later in the Recreational Use assessment are indicative of sewage and urban stormwater inputs.

Linworth Run (RM 9.99)

This tributary enters the Lower Olentangy from the west downstream from 1-270N and was likewise impaired with a fair macroinvertebrate narrative and an IBI of 26. Nearly identical results were obtained by Ohio EPA (2001) in 1999. The QHEI of 63.0 was good, but shallow depths prevailed due to intermittent flows an observation also made by Ohio EPA (2001). It was assessed with the Primary Headwater Habitat (PHWH) methodology which yielded a Class 3A result. Nutrient, demand, and ionic strength parameters in the water column were consistent with suburban development including a highly elevated level of zinc. Sediment chemistry data indicated no exceedances for metals, but three (3) low level and five (5) high level exceedances for PAH compounds indicate a significant impact from stormwater runoff. The elevated *E. coli* levels that are discussed later in the Recreational Use assessment are indicative of sewage and urban stormwater inputs.

Unnamed Tributary @RM 8.45

This tributary also enters the Lower Olentangy from the west across from the south side of Antrim Park. It is nestled in a steep ravine and has a mature woody riparian buffer as a result. The non-attainment status was due to a fair macroinvertebrate narrative and an IBI score of 30. The QHEI of 65.0 was very good and there were only two (2) moderate influence modified attributes. Water quality was also good as evidenced by very few indications of urban stormwater and zero detections of metals or PAH compounds in sediment.

Turkey Run (RM 5.82)

This tributary also enters the Lower Olentangy from the west across and downstream from the Adena Brook confluence. The watershed is of a lower relief compared to the tributaries that are nestled in ravines and is more susceptible to riparian encroachment from the predominance of urban land uses. Still the QHEI score of 69.5 was very good with only a few modified attributes. Nutrient, demand, and ionic strength parameters in the water column were low excepting for a

highly elevated level of zinc. Sediment chemistry data indicated no exceedances for metals, but three (3) low level and five (5) high level exceedances for PAH compounds indicate a significant impact from stormwater runoff. *E. coli* levels that are discussed later in the Recreational Use assessment were not highly elevated relative to adjacent tributaries in 2022, but this tributary was a principal source of high fecal and *E. coli* levels in the Olentangy River in 1999 (Ohio EPA 2001) are indicative of sewage and urban stormwater inputs.

Walhalla Hollow (RM 4.52)

This tributary enters the Lower Olentangy from the east in Clinton-Como Park upstream from the Union Cemetery Dam. It is nestled in a steep ravine and is closely bordered by a street along most of its length. The 2003 Ohio EPA (2005) biological and water quality assessment left Wahalla Hollow undesignated since it was judged to be incapable of supporting a WWH fish assemblage. The biological results in 2022 produced no fish for an IBI score of 12 and a poor macroinvertebrate narrative which verified the prior Ohio EPA findings. The QHEI of 47 indicates a marginally fair quality habitat with shallow depths and lack of flow the major limiting factors. It was also assessed with the PHWH methodology, but that yielded only a Class 2 result at best. Chemical impacts were the most evident in the sediment results with elevated lead, zinc, and 12 PAH compounds including the highest total of any tributary and seven (7) highly elevated compounds. *E. coli* levels that are discussed later in the Recreational Use assessment were extremely elevated with the mean exceeding 1500 cfu/100 mL and maximum exceeding 3000 cfu/100 mL due to frequent inputs from sanitary relief points or SSOs.

Glen Echo Ravine (RM 4.10)

This tributary also enters the Lower Olentangy from the east in Clinton-Como Park upstream from the Dodridge Dam. It is nestled in a steep ravine and is closely bordered by a street along most of its length. The QHEI of 57.0 was marginally good and sufficient to support a WWH aquatic life use designation that was assigned by Ohio EPA (2005). However, due to shallow depths, intermittent flows, and the restricted access by fish due to the close proximity of the Dodridge and Union Cemetery Dams in the mainstem no fish were collected resulting in an IBI of 12 and a poor macroinvertebrate narrative which verified the prior Ohio EPA findings. Chemical impacts were likewise the most evident in the sediment results with elevated copper, lead, and zinc, and 11 PAH compounds including the second highest total of any tributary and six (6) highly elevated compounds. *E. coli* levels that are discussed later in the Recreational Use assessment were extremely elevated with the mean exceeding 1400 cfu/100 mL and maximum exceeding 6000 cfu/100 mL due to frequent inputs from SSOs.

Recreational Use Assessment

Exceedances of the 90-day geometric mean and STV *E. coli* PCR criteria in the Olentangy River mainstem in 2022 started below Broad Meadows Dam and the Linworth Run (RM 9.99) and Rush Run (RM 8.75) confluence (site OLN11), increasing in magnitude and severity in the Dodridge Street Dam impoundment (Site OLN12) and for the remainder of the lower mainstem to the confluence with the Scioto River (Table 5). Exceedances of the PCR mean criterion occurred between OLN09 and OLN11, but were below the STV criterion. The exceedances

Table 5. *E. coli* values (cfu/100 mL) for samples collected in the Olentangy River mainstem during June-October 2022. Yellow shaded values exceeded the recommended 90-day geometric mean (126 cfu/100 mL) and orange shaded values exceeded the maximum STV (410 cfu/100 mL) Primary Contact Recreation (PCR) use criteria. Red shaded values exceeded the Secondary Contact Recreation (SCR) use criterion.

Site ID	River Mile	Drainage Area (mi. ²)	Samples	Date of Minimum	Minimum	Mean	Maximum	Date of Maximum
Olentangy River								
OLN05	14.9	482	6	Oct. 19	31	116	220	Aug. 29
OLN07	13.1	489	6	Oct. 10/19	41	84	170	Aug. 29
OLN08	12.0	490	6	Oct. 10	20	67	140	Sept. 1
OLN09	8.5	510	6	Oct. 10	20	205	2100	Sept. 19
OLN10	6.8	516	6	July 27	120	372	1400	Sept. 19
OLN11	5.5	524	6	July 27	170	361	710	Aug. 25
OLN12	4.5	529	6	Oct. 3	230	953	3100	June 23
OLN01	3.9	531	6	Oct. 20	180	1055	5200	June 23
OLN02	2.0	537	6	Oct. 20	250	1165	8700	June 23
OLN03	1.5	537	6	Oct. 20	310	1297	10000	June 23
OLN04	0.3	543	6	Oct. 20	240	979	8200	July 28
	exceedance of Primary Contact Recreation (PCR) geometric mean criterion of 126 cfu/mL.							
	exceedance of PCR Statistical Maximum Value (STN) criterion of 410 cfu/mL.							
	exceedance of Secondary Contact Recreation (SCR) maximum criterion of 1030 cfu/mL.							

increased in magnitude at OLN12 and the four (4) sites downstream of the Dodridge Dam to the mouth. The mean *E. coli* value at three of the lower four (4) sites exceeded the SCR criterion while the maximum *E. coli* counts exceeded 5,000 cfu/100 mL a level that generally means human sewage as a primary source. Maximum values exceeded the SCR criterion beginning at site OLN09 and except for one site (OLN11), increased in magnitude exceeding 5,000 cfu/100 mL at all sites between OLN01 to the mouth. The highest value of 10,000 cfu/100 mL occurred at site OLN03 at Third Ave. The 2022 mean values exceeded that observed in 2020 and 1999, but were similar to the Ohio EPA results in 2003.

The mean and maximum *E. coli* results in the Olentangy River tributaries revealed consistent exceedances at every site sampled in 2022 (Table 6). Four mean values exceeded the STV while the remaining eight (8) exceeded the SCR criterion a result that amplifies the magnitude of the PCR exceedances. All of the maximum values exceeded the PCR STV criterion with all except two exceeding the SCR criterion with a high value of 12,000 cfu/100 mL at ADN02 in Adena Brook. The furthest upstream tributary, Bartholomew Run (RM 14.48), had PCR mean and STV exceedances, but of a lesser magnitude and with the mainstem meeting the PCR mean and STV criteria at OLN07 downstream from the Olentangy ECC and OLN08 upstream from I-270N (Table 5). All of the tributary minimum values exceeded the PCR mean with eight (8) exceeding the

Table 6. *E. coli* values (cfu/100 mL) for samples collected in the Olentangy River tributaries during June-October 2022. Yellow shaded values exceeded the recommended 90-day geometric mean (126 cfu/100 mL) and orange shaded values exceeded the maximum STV (410 cfu/100 mL) Primary Contact Recreation (PCR) use criteria. Red shaded values exceeded the Secondary Contact Recreation (SCR) use criterion.

Site ID	River Mile	Drainage Area (mi. ²)	Samples	Date of Minimum	Minimum	Mean	Maximum	Date of Maximum
Bartholomew Run (RM 14.48)								
BAR01	0.2	1.13	4	Aug. 24	680	789	880	June 22
Linworth Run (RM 9.99)								
LIN01	0.8	2.58	4	July 11	340	526	1400	Sept. 12
Rush Run (RM 8.75)								
RSH01	0.25	2.62	4	June 16	910	1923	4700	Aug. 23
Tributary to Olentangy River (RM 8.45)								
TRIB01	0.1	1.08	4	June 22	260	686	2900	Sept. 22
Tributary to Olentangy River (RM 7.82) (Bill Moose Run)								
BMR01	0.2	2.69	4	June 16	520	1657	3100	July 21
Adena Brook (RM 6.0)								
ADN04	1.6	1.80	4	June 16	600	1171	2600	Sept. 12
ADN03	1.0	2.28	4	June 16	840	1101	1600	Aug. 23
ADN02	0.7	2.66	4	June 16	610	1568	12000	Sept. 22
ADN01	0.2	2.71	4	June 16	610	1257	3200	Sept. 22
Turkey Run (RM 5.82)								
TUR01	0.70	2.09	4	July 11	310	482	750	Sept. 22
Wahalla Hollow (RM 4.58)								
WAH01	1.0	1.13	4	June 22	930	1567	3100	Sept. 22
Glen Echo Ravine (RM 4.10)								
GER01	1.0	0.6	4	Aug. 24	480	1408	3600	June 22
	exceedance of Primary Contact Recreation (PCR) geometric mean criterion of 126 cfu/mL							
	exceedance of PCR Statistical Maximum Value (STN) criterion of 410 cfu/mL							
	exceedance of Secondary Contact Recreation (SCR) maximum criterion of 1030 cfu/mL							

STV. Taken together the results indicate sustained exceedances of the PCR recreational use *E. coli* criteria during summer-fall normal flows.

The relationship of the mean to the maximum values in the mainstem in 2022 suggests higher loadings and intermittent pulses of *E. coli* beginning at OLN09, which is downstream from Linworth Run (RM 9.99) and Rush Creek (RM 8.75), and extending downstream to OLN12 in the Dodridge Dam impoundment (Figure 4). From this point downstream the means were more elevated relative to the maximum suggesting a more sustained input of *E. coli* from this point downstream. The “boundary” of the intermittent and more sustained inputs is at the boundary between the reach affected primarily by SSOs and the lower reach affected by CSOs. Most of the SSO inputs are conveyed by tributaries from Rush Run downstream to Glen Echo Ravine.

The 2020 MBI and 1999 Ohio results showed the increase in the mean occurring downstream from Turkey Run at OLN11 whereas the 2022 MBI and 2003 Ohio EPA results show the increase occurring further upstream to the confluence with Rush Run above site OLN09. While Bartholomew Run had significant exceedances of the PCR mean and STV criteria (Table 6), the mainstem results show relatively smaller impact by those tributaries relative to sites downstream (Figure 4). Pinpointing the exact sources of *E. coli* exceedances will require more dense sampling between Linworth Run and Rush Creek and also to include several small and unnamed tributaries that enter the Olentangy in the affected lower reach. Fecal bacteria indicators like *E. coli* are prone to exhibiting false positives from non-human sources and are predictably elevated above the PCR mean and STV criteria in urbanized areas. However, the pattern in the frequency and magnitude of the exceedances of the mean and maximum values in the lower 8-9 miles of the mainstem suggest sewage as a contributing source. SSOs and other cross connections between the sanitary and storm sewer system are prevalent in the Riverlea, Beechwold, and Clintonville areas between the Rush Run confluence downstream to the mouth (Ohio EPA 2001; DOSD 2015)². The mean values in 2022 were highly elevated compared to 2020

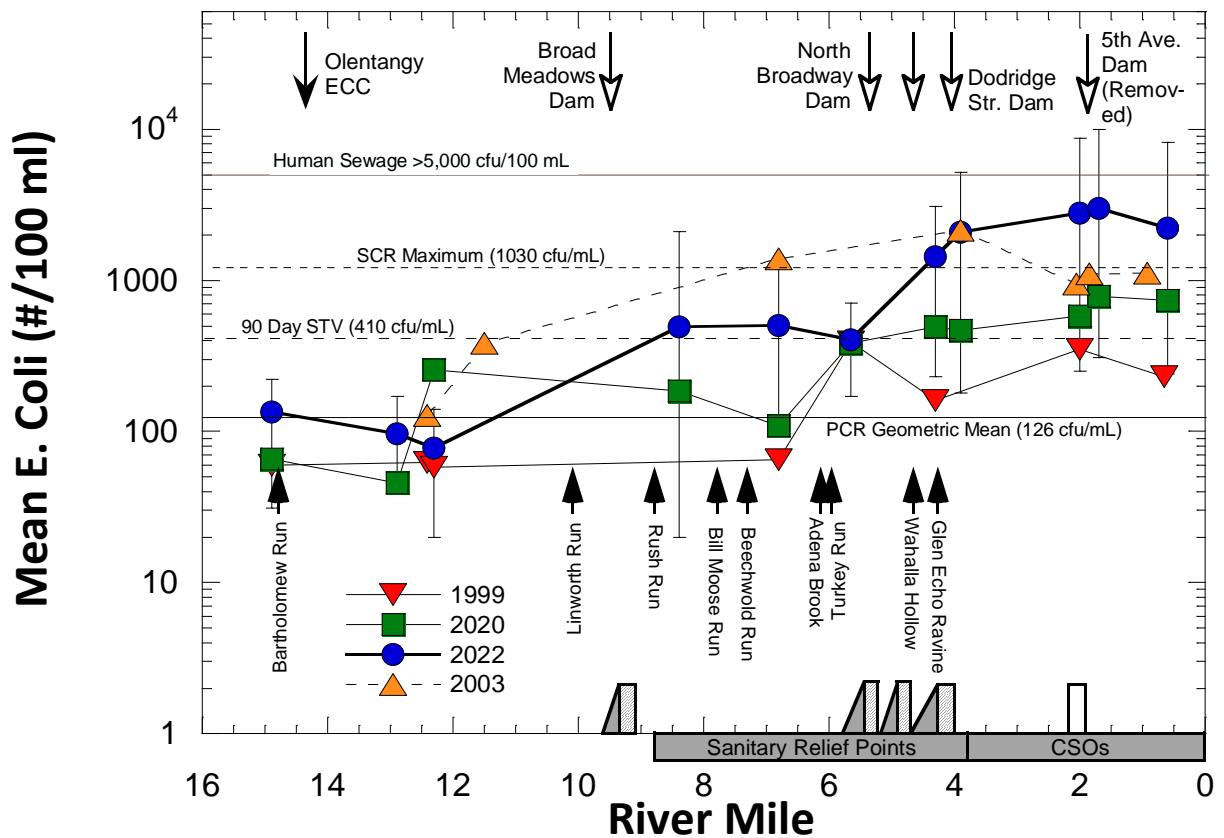


Figure 4. Mean *E. coli* values in the Olentangy River mainstem in 1999, 2003, 2020, and 2022 relative to the PCR mean and STV criteria and the SCR criteria. Tributaries are listed along the mainstem with those entering from the east inverted left to right and those entering from the west right to left. The reaches affected by sanitary relief points (SSOs) and CSOs are indicated along the bottom.

² <https://columbus.maps.arcgis.com/apps/dashboards/24f57525213544e7b1ed6da19baf36a1>

and similar to values observed in 2003 by Ohio EPA where exceedances of the Secondary Contact Recreation (SCR) criterion of 1,030 mg/L regularly occurred in the lower four (4) miles of the mainstem (Figure 4). Based on the relationship between the mean and maximum values in 2022 the highest and most frequent exceedances occurred with the presence of active CSOs downstream from Dodridge Street (OLN01) to the mouth. Blueprint Columbus and the Lower Olentangy Tunnel (LOT, or OARS Phase II project should reduce sewage inputs via storm sewers and from CSOs when those projects are completed by 2026. The next survey of the Olentangy mainstem and tributaries should be undertaken periodically to monitor incremental changes as these projects are implemented and completed.

Synopsis of Current Issues for Central Ohio

Hydrologic Regime

Flow is a critical factor in determining how pollution affects aquatic life and other designated uses. As such it is important to understand the flow regime under which a biological and water quality assessment is conducted. While most all of the sampling is conducted under “normal summer-fall season flows” by design, the dynamics of the seasonal flow regime are important to document and understand. The flow regime can vary from year to year and this has been somewhat cyclical in the Scioto River basin, although climate change has the potential alter its regularity and predictability in the future. Chemical water quality is directly affected by flow in terms of the concentration of pollutants and indirectly in terms of the duration and magnitude of exceedances of critical thresholds comprising an adverse exposure to aquatic life, wildlife, and humans. Primary production in terms of chlorophyll *a* is affected in terms of the productivity of sestonic and benthic algal assemblages and the impact that photosynthesis and respiration have on the diel D.O. regime. The D.O. regime in turn has direct effects on the health and well-being of aquatic life which can become manifest in non-attainment of the biological criteria or other symptoms of altered functions within the aquatic ecosystem. The dynamics of pH are likewise affected which can in turn affect the toxicity of key pollutants such as ammonia and certain heavy metals. Biological assemblages are not as instantaneously responsive to changing flows as are water chemistry and primary production, but they can be adversely affected by the increased exposure to adverse effects resulting from either factor under extended periods of “worst case” low flow conditions and likewise by habitat alterations caused by higher flow levels.

The flow regime in the Scioto River downstream from the Olentangy River is heavily influenced by two factors; 1) flow releases by the Delaware Dam approximately 26 miles upstream, and 2) withdrawals of water by the Dublin Rd. WTP which can seasonally remove nearly all of the flow in the Scioto River at the WTP intake leaving little or no flow in the Scioto between the WTP and the Olentangy River, a distance of more than one mile. The Delaware Dam can provide for sustained elevated flows, especially if runoff in the upper watershed in Delaware, Marion, and Wyandot Counties is elevated, to maintain the summer recreational pool in the Delaware Reservoir. In contrast, the Dublin WTP can exacerbate low flow periods as the demand for drinking water is independent of available downstream flows. While the potential effects of sustained low flows in the Scioto River below Columbus are obvious, the intermittent spates of

elevated flows resulting from releases by the Delaware Dam are not well understood. However, the potential beneficial effect of periodic spates of elevated flows, thus “relieving” periodic low flow stresses due to nutrients or other pollutants needs to be better evaluated and understood.

The summer-fall flow regime in 2022 was “average” with extended periods of flows below the 50th percentile, but above the 90th percentile flow over most of the seasonal index period. For reference the 50th percentile flow at the USGS Columbus gage located just downstream from Frank Rd. of 531 cfs (cubic feet per second) is 10 times the $Q_{7,10}$ flow of 53.1 cfs and more than four (4) times the 90th percentile flow of 128 cfs. Wasteload allocations (WLA) for point sources are based on the $Q_{7,10}$ flow³ as a “worst case” condition. Compared to the most recent survey years of 2010 and 2015, minimum flows were lower in 2010 and mostly the same or slightly higher in 2015. The most recent year of extended critical low flows occurred in 1988.

Nutrient Effects Assessment

The assessment of nutrient effects is a relatively recent concept and is intended to focus on the actual effects of nutrients on aquatic life and aesthetics as opposed to strict compliance with numerical phosphorus and nitrogen criteria. Ohio EPA has been a leader in developing what are also referred to as “combined” nutrient criteria, first developing the Stream Nutrient Assessment Procedure (SNAP; Ohio EPA 2015b) and later with the large river nutrient assessment procedure (Miltner 2018). MBI has gained experience with conducting these types of assessments by using and modifying the SNAP procedure in Ohio and Illinois since 2013 and merging it with the large river procedure in the Scioto and Olentangy Rivers in 2022. The primary parameters include total phosphorus, nitrate-N, the diel D.O. swing, minimum D.O., and maximum D.O., all from continuous measurements over 4-5 days, sestonic chlorophyll *a*, and benthic chlorophyll *a*. Secondary parameters that can be affected by nutrient enrichment include BOD₅, total suspended solids (TSS), and total Kjeldahl nitrogen (TKN). The status of aquatic life use attainment is also an important variable and can be a determining factor in the assignment of nutrient enrichment status and how specific sources are dealt with. New in 2022 was the deployment of Datasondes at three (3) sites continuously over the mid-July to mid-September to better understand within season dynamics and to assess the representativeness of the short-term deployments at more sites.

For the 2022 nutrient effects assessment of the Scioto River mainstem, all chlorophyll *a* data (benthic and sestonic) with a single exception were well within acceptable levels defined by Ohio EPA (2015b) and Miltner (2018). One site in the Scioto River just upstream from the Circleville WWTP had a moderately elevated benthic chlorophyll *a* level. The levels of total P and nitrate-N were above the “acceptable” thresholds of 0.13 mg/L and 1.56 mg/L, respectively (Miltner 2018) at every Scioto River site downstream from Jackson Pike to downstream from Circleville. Other indicators that exceeded the acceptable thresholds of Miltner (2018) were the diel D.O. swing at seven (7) sites mostly in the lower Scioto River mainstem, but also several sites in the upper mainstem between Griggs Reservoir and the Greenlawn Dam impoundment. The Ohio EPA TKN “over-enriched” threshold of 0.75 mg/L and BOD₅ “enriched” threshold of

³ Some WLAs (e.g., ammonia-N) are based on the $Q_{30,10}$ flow per OAC 3745-2.

2.5 mg/L were exceeded at all Scioto sites with no apparent pattern related to any particular source. The solid WWH and EWH use attainment offsets these chemical threshold exceedances in keeping with OAC 745-1-07(C)(1) for demonstrated attainment of the applicable biocriteria. In terms of historical trends, total P showed a decline in the Greenlawn to Circleville reach based on data between 1970 and 2022. Maximum and mean values both declined with maximum values showing the most apparent decrease with values as high as 5 mg/L declining to less than 0.5 mg/L by 2015. TKN and BOD₅ showed a similar decline through the same time period. Nitrate-N values showed a less marked decline with maximum values as high as 10 mg/L in the early 1980s declining to 6 mg/L or less by 2010-20. Mean nitrate-N values showed little change through the entire 50 year time period, however.

Short-term Datasonde Deployments

The results of the Scioto and Olentangy River longer term deployments suggest that the short-term deployments were effective at covering the critical periods for the summer months of 2022. However, the long term deployments also revealed extended periods of “relief” from exceedances of the nutrient effect related D.O. thresholds. A key question then is about the actual effect of short term exceedances vs. the long term results which will inherently include less stressful periods due to the potential “relief” effects of periods without exceedances. A concept similar to the stress/recovery for temperature developed by Bevelhimer and Bennet (20007) would be worth exploring for application to the duration of D.O. exceedances.

Ammonia-N

This single, but very important parameter is highlighted because of its toxicity to aquatic life and the implications of the U.S. EPA (2013) ammonia criteria document that added the apparent lower sensitivity of freshwater mollusks to the ammonia toxicity database. This could potentially lower the equivalent total ammonia-N that would be used as a design target in a revised wasteload allocation. In addition, the Ohio WQS have different ammonia criteria between the WWH and EWH aquatic life uses, thus a redesignation of the Scioto River to EWH below Big Walnut Creek would result in a slightly more stringent total ammonia-N criterion. The EWH designation itself would not have a direct impact to either WWTP as both discharge to currently designated and fully attaining WWH and EWH reaches. The new U.S. EPA (2013) criterion could have a more direct impact as mussels are present along the entirety of the Scioto River mainstem.

As part of the 2020 assessment, MBI (2022) conducted an analysis of the resulting total ammonia-N criteria values based on reach-specific 75th percentile temperature and pH values per the Ohio WQS Implementation Rules (OAC 3745-2). Depending on the reach specific temperature and pH datasets that were used, the WLA target for WWH varies between 0.50-0.80 mg/L as total ammonia-N, is 0.50 mg/L for the proposed EWH reach of the Scioto River downstream from Big Walnut Creek, is 0.60 mg/L for the existing EWH reach of the Olentangy River, and 0.32-0.34 mg/L for the Scioto River mainstem reaches and 0.39 mg/L for the Olentangy River mainstem based on the U.S. EPA (2013) criteria. The latter results in a roughly 50% reduction in allowable total ammonia-N compared to WWH and somewhat less than that for EWH. The *maximum measured* ammonia-N in 2020 ranged from 0.092-0.240 mg/L in the

Scioto River and 0.680 mg/L in the Olentangy River with that single high value being measured downstream from the Olentangy Environmental Control Center (ECC). While this was the only measured value that exceeded the applicable ammonia-N criteria for EWH or the U.S. EPA (2013) criteria, the design values in a revised WLA would be applied at the $Q_{30,10}$ flow which is about 25% of the lowest flows observed during 2020. It will be important to repeat an ambient water quality survey under lower summer-fall flows to be certain of the potential impacts.

In terms of historical trends dating back to 1970, ammonia-N has shown the most visible and distinct decline of any of the chemical pollutants. Maximum and mean values >6.00 mg/L in the early 1970s declined sharply following the installation of advanced wastewater treatment at both Columbus WWTPs by Project 88. With the exception of the maximum values >1.50 observed in 2004 and 2010, all values have been well below the WWH water quality criterion of 0.60 mg/L, the EWH criterion of 0.50 mg/L, and the U.S. EPA (2013) criteria of 0.32-0.34 mg/L.

Dissolved Ions and Other Chemical Parameters

The remainder of the chemical data revealed no other exceedances of chronic or acute water quality criteria in the Ohio WQS, which is not an unexpected finding. Common pollutants have largely been controlled and are infrequently measured at levels exceeding detection limits in grab water samples under summer normal flows. Other parameters that either have outdated criteria or no criteria at all have emerged as being more indicative of potential future pollution problems. Dissolved ionic strength parameters such as chlorides, total dissolved solids, and conductivity are such examples. The long term analysis of trends that showed the common wastewater associated pollutants declining dramatically over the past 50 years, revealed increasing trends in dissolved ions such as TDS, chlorides, and conductivity in the study area. Chloride in particular showed an increasing trend for both maximum and mean values between the late 1960s and 2020 exceeding the recently developed Ohio hazard threshold of 52 mg/L (Miltner 2021) on a regular basis. While no values exceeded the U.S. EPA criterion of 230 mg/L, the data presented herein are summer-fall values that reflect residual levels from winter road salt applications. The longitudinal plots of these parameters also show the WWTPs to be sources as median and maximum concentrations increased 20-40 mg/L over 25 miles downstream from the Jackson Pike WWTP and remained above the recently developed 52 mg/L hazard level (Miltner 2021), but at or below the Ohio large rivers reference value of 68.5 mg/L for the ECBP ecoregion (Ohio EPA 1999a). Chemicals were also measured in sediments and these, too, were evaluated by available effect and reference thresholds. None were egregiously elevated. Sediment chemistry can be more revealing than water column sampling about the longer term occurrence of certain contaminants and compounds. In the smaller tributary subwatersheds this could have implications for stormwater management.

Recreational Use Assessment

Recreational use attainment was determined by using *Escherichia coli* (*E. coli*) mean and maximum values that approximate the water quality criterion expressed as a 90-day geometric mean and a Statistical Threshold Value (STV). These criteria are codified in OAC 3745-1-37(C) with 126 cfu/100 mL for the 90-day geometric mean and 410 cfu/100 mL for the STV, respectively. With only six samples collected at each mainstem site this amounts to a screening

assessment using the average and maximum values in lieu of true geometric mean and STVs at each site for the Primary Contact Recreational (PCR) use subcategory (Table 2). Exceedances of the geometric mean and STV thresholds were minor and unrelated to any sewage source. They occurred between the site located just downstream from the Dublin Rd. WTP Dam (SR02) and the first site downstream from Columbus Southerly (SR 12). In 2020, the magnitude of exceedances of the STV were higher at every site in downtown Columbus upstream from the Greenlawn Dam, but with fewer sites exceeding the mean which is an indication of episodic values that are likely related to runoff events. Maximum values exceeded the Secondary Contact Recreation (SCR) STV criterion at six (6) sites in 2020, but none in 2022. Fecal bacteria indicators like *E. coli* are vulnerable to false positives from non-human sources and are predictably elevated in urbanized areas. No exceedances of either PCR threshold were measured downstream from Big Walnut Creek. A single high value in Big Walnut Creek exceeded the STV, but the mean was well below the PCR geometric mean criterion. None of these results present a threat to recreation in an on the water.

Emerging Issues and Threats

New Generation or “Emerging” Chemical Pollutants

Contaminants of emerging concern (CECs), including pharmaceuticals and personal care products (PPCPs), have increasingly been detected at low levels in surface water, and there is concern that these compounds may have an impact on aquatic life. U.S. EPA has been evaluating the potential impact of CECs and PPCPs on aquatic life and have outlined an approach for determining protective levels for aquatic organisms. Several CECs and PPCPs act as so-called endocrine disruptors (EDCs). EDCs are compounds that alter the normal functions of hormones resulting in a variety of health effects. EDCs can alter hormone levels leading to reproductive effects in aquatic organisms, and evaluating these effects may require testing methodologies not typically available along with endpoints not previously evaluated using current guidelines. Emerging contaminants may also demonstrate low acute toxicity, but cause significant reproductive effects at very low levels of exposure. In addition, the effects of exposure to aquatic organisms during early life stages may not be observed until an organism becomes an adult. Therefore, traditional toxicity test endpoints may not be sufficiently comprehensive for criteria derivation for these chemicals and the chemicals may also have specific modes of action that may affect only certain types of aquatic animals (e.g., vertebrates such as fish)⁴.

The current attention being generated by PFAS and PFOA compounds is another emerging subject of concern and is reminiscent of the level of attention garnered by PCBs in the 1970s and dioxin in the 1980s. The result then was the derivation of water quality criteria and monitoring of each as appropriate to better advise the public about risks of exposure via contact and consumption of water and fish and regulating sources accordingly. Their elimination has proved to be difficult as each is still detected in the aquatic environment.

⁴ <https://www.epa.gov/wqc/contaminants-emerging-concern-including-pharmaceuticals-and-personal-care-products>.

Based on the results of both the 2020 and 2022 biological and water quality surveys, several categorical forms of pollution stand out. These include nutrient enrichment effects, dissolved ions, ammonia, hydrological alteration, urban stormwater (i.e., metals and PAH compounds), and bacterial contamination from urban and sewer system related sources. This approach includes the integrated assessment of both *pollutants* and non-pollutant stressors within the broader sphere of ascertaining the effects of *pollution* as opposed to a singular focus on selected *pollutants* alone. Future issues could include an array of emerging pollutants, plus others that are less well known such as antibiotics and anti-microbial resistance (Ballash et al. 2022), and likely to include *some* of the nearly 600 chemicals that were detected in a recent USGS survey of urban watersheds (Bradley et al. 2023). This number of chemicals is beyond the reach of even the most comprehensive baseline monitoring programs and laboratory capacity, hence a judicious approach that operates within the constraints of the reasonable potential to encounter such substances and the plausible risk for harm needs to be taken. At this time there is no direct evidence that unmeasured or unknown pollutants are posing an imminent threat to the predominantly full attainment of the WWH and EWH uses in the Scioto River and Olentangy River mainstems. The sustained good and exceptional quality of the fish and macroinvertebrate assemblages does not suggest any imminent threats as the biota has steadily improved over 35+ years, once extirpated species and taxa have reoccupied their former pre-pollution ranges, and the high level of quality has been maintained following the apparent pinnacle of recovery being reached in 2015-20. Most of the emerging contaminants have been present in wastewater and urban runoff for nearly three decades and substances like PFAS and PFOA have been in production and use for several decades more. However, prudence dictates that the risks posed by “new” chemicals be better understood and tracked accordingly, all of which has significant implications for wastewater treatment and the MS4 program.

Status of the Mussel Fauna

The discovery of mussel shells in relatively good condition representing several long extirpated state and federally listed species and one extinct species within two miles downstream of the first discharge of sewage by the City of Columbus has renewed interest in having a more current inventory of mussel species in the Scioto River. Hogarth (2023) just completed a reassessment of the Olentangy River mainstem including our 2020 and 2022 survey areas, but the most recent and spatially complete survey of the Scioto River mainstem by Tetzloff and Akison (1999) is now 25 years old. This survey predated the complete recovery of the fish assemblage documented by the MBI and DOSD surveys of 2020 and 2022 and the more advanced ingress of fish species that were extirpated by the gross pollution of the 19th and 20th centuries. Mussels are reestablished naturally by a dependence on their fish hosts reoccupying places where they were also eradicated by the historically gross pollution of the Scioto River mainstem in the 19th and 20th centuries. Besides gaining current knowledge about what is the most endangered assemblage of the aquatic fauna in Ohio and the Midwest U.S., it would also support planning for the imminent consideration of the 2013 U.S. EPA ammonia criterion by Ohio EPA, which is based largely on the sensitivity of Unionid mussels to ammonia. Besides the potential effects of present day water quality, hindrances posed by the altered hydrology and barriers to fish passage described herein and in the 2020 report (MBI 2022) may be more limiting to Unionid mussel recovery and a better place to focus restoration resources.

INTRODUCTION

The status of aquatic life and water quality in the Scioto and Olentangy River mainstems and Olentangy River tributaries that was assessed in 2022 has direct implications for the City of Columbus Dept. of Public Utilities (DPU), Division of Sewers and Drains (DOSD) and at least indirectly for the Division of Water (DOW). The Olentangy and Scioto River mainstems are the principal receiving waters of discharges from wastewater infrastructure, including the two major wastewater treatment plants (WWTPs), the sewer system itself, and stormwater. It is therefore important to have an accurate understanding of not only the current status of biological condition, habitat, and water quality, but to document its trajectory over time. This can critically affect our understanding of the efficacy of current regulations, the need for future regulations, and the capacity and operation of critical infrastructure to meet the challenges of a growing population and expanding human activities across Central Ohio.

The most recent formal biological and water quality assessment of the Central Ohio portions of the Scioto River basin by the Ohio EPA is based on data collected in 2010-12 for the Scioto River and 1999 and 2003 for the Olentangy River. DOSD has made substantial improvements to wastewater infrastructure since the intensive Ohio EPA biological and water quality surveys including the elimination of combined sewer overflows (CSOs), addressing urban sewage and stormwater infrastructure via Blueprint Columbus, and increasing wastewater treatment capacity and reliability on a continuing basis. In the meantime, various phases of WQS rulemakings for nutrients, ammonia, and other relevant issues are in the Early Stakeholder or Interested Party Review phases. Revisions to use designations for portions of the Olentangy and Scioto River mainstems were adopted in 2022 and were the result of Level 3 surveys by MBI in 2015 and MBI with DOSD support in 2020.

While the Ohio EPA database was supplemented by a 2015 biological and habitat assessment conducted by MBI under a Level 3 Project Study Plan (PSP), the full effect of recent DOSD actions had not yet been fully realized. Added to this is that in 2017-18 Ohio EPA reduced the intensity and frequency of watershed and mainstem monitoring and assessment that had been a staple of that program for nearly 40 years. This was followed in 2018-19 by the agency proposing and implementing a new Two-Pronged strategy for statewide monitoring and assessment that reduces the acuity and relevance of prior assessments of mainstem rivers and watersheds and lessening the connection with historical trends by virtue of that reduction. As part of the initial roll out of this revised approach, Ohio EPA sampled large river assessment units statewide in 2020-21, which included the lower Olentangy and Scioto River mainstem in and downstream from Columbus in 2021. A draft report about the results was released for review (Ohio EPA 2023), but there were too few sites in either the Scioto or Olentangy mainstems to make anything other than general comparisons with the 2020 or 2022 DOSD surveys. Only 10 sites were allocated in the reaches of the Scioto and Olentangy Rivers⁵ whereas DOSD supported sampling 38 sites in 2020 and 2022, emulating and building on the former pollution survey approach historically employed by Ohio EPA. The reduction in spatial

⁵ The planned 2020 monitoring was delayed to 2021 by COVID-19 pandemic related restrictions at Ohio EPA.

intensity by Ohio EPA has inevitably shifted much of the burden for documenting water quality compatible with the historical database to permittees and local and regional jurisdictions for the reasons stated above. It is therefore critical for DOSD to have the most accurate and up to date knowledge at a level of detail that allows for better planning and responding to pending initiatives from Ohio EPA, U.S. EPA, and third parties. There are six such examples at present:

1. The proposed large river nutrient assessment procedure proposed by Ohio EPA has implications for phosphorus and nitrogen limitations at the two major WWTPs and the sewer system itself. This will eventually impact MS4 requirements in all likelihood.
2. A growing concern about the impact of nutrients delivered mostly by nonpoint sources in the upper Scioto River drainage has direct implications for DPU, Division of Water (DOW) and at least indirect implications for DOSD in terms of what might result from nutrient trading that is seen as a way to balance nutrient loadings between point and nonpoint sources, sometimes in an overly simplistic manner.
3. A recent filing by a consortium of Nongovernmental Organizations (NGOs) requests U.S. EPA to require the Ohio River basin states adopt numerical nutrient criteria and develop a TMDL to address harmful algal blooms (HABs) in the Ohio River mainstem. This could have a direct impact on future nutrient parameter permit limitations.
4. The U.S. EPA (2013) recommendations for revised ammonia water quality criteria that include the consideration of freshwater mollusks (mussels and snails) that have been determined to be the most sensitive aquatic assemblage. This is likely to be part of the next Ohio EPA triennial review (2023-24) and it would result in more stringent ammonia criteria potentially affecting current effluent limits at Jackson Pike and Southerly.
5. The upgrade of the use designation of the Scioto River downstream from the Columbus Southerly WWTP from Warmwater Habitat (WWH) to Exceptional Warmwater Habitat (EWH) was based on the demonstrated attainment of the latter by MBI in 2015 and again in 2020 and 2022 by DOSD. It is unlikely that this will impact current permit limitations.
6. The Intel development in New Albany will increase wastewater inflows to Southerly by 2.5 MGD initially, with increased inflows expected in the future. The accompanying development of housing and related land use changes will affect watersheds within Columbus MS4 jurisdiction as well.

Addressing these issues independently is not only imprudent, but could produce requirements that conflict with the realities of the current high quality status of portions of the Scioto and Olentangy Rivers resulting in potentially costly and unnecessary expenditures. Added to the above examples are other factors including a projected population growth of one-half million people by 2050 that will not only place new demands on existing wastewater infrastructure, but also increase impacts to watershed integrity from the accompanying landscape development. That alone could conflict with the hard won improvements in biological condition and water quality that have been documented over the past 50 years. Conventional approaches to addressing the water quality issues that accompany such changes are simply inadequate without the confirming observations provided by the monitoring and assessment program initiated by DOSD in 2020 and 2022 and that to be recommended for 2024 and beyond.

METHODS

Monitoring Design

An intensive pollution survey design that employs a high density of sampling sites and paired biological, chemical, and physical indicators and parameters was followed in 2022 the same as it has been periodically performed in the study area since 1979 by Ohio EPA and more recently by MBI (2019) in 2015 and MBI and DOSD in 2020 (MBI 2022). The principal objectives of the 2022 assessment are to report aquatic life and recreational use attainment status, following the Ohio WQS and former Ohio EPA practices, and determine associated causes and sources of impairments. To accomplish this monitoring sites were positioned upstream and downstream from major discharges, sources of potential releases and contamination, and major physical modifications to provide a “pollution profile” along the Scioto and Olentangy River mainstems. The result was a design that included chemical, physical, and biological sampling at 27 sites in the Scioto River (includes two mixing zones and Big Walnut Creek), 11 sites in the Olentangy River, and 12 sites among nine (9) Olentangy River tributaries. Each site was assigned a unique site code as depicted in Figure 1 and in Appendix Table A-1. While most of these sites repeat the 2020 survey, the new Olentangy tributary sites were added to address a more than 20 year gap in that database all except Adena Brook last being surveyed in 1999 and 2003 by Ohio EPA.

Biological and Water Quality Surveys

A biological and water quality survey, or “biosurvey”, is an interdisciplinary monitoring effort coordinated on a water body specific or watershed scale. Biological, chemical, and physical monitoring and assessment techniques are employed in biosurveys to meet three major objectives:

1. Determine if use designations and/or goals set for or assigned to a given water body are appropriate and attainable;
2. Determine the extent to which use designations assigned in the state Water Quality Standards (WQS), or equivalent policies or procedures, are either attained or not attained; and,
3. Determine if any changes in ambient biological, chemical, or physical indicators have taken place over time, particularly before and after the implementation of point source pollution controls or best management practices.

The data were managed by MBI in a relational database that supports the integrated analysis of ambient chemical, physical, and biological data and pollution source information and characterization. The findings are analyzed and depicted in a written report with causes and sources of impairments being described as to their extent and severity along with any recommendations for their eventual resolution.

Measuring Incremental Changes

Incremental change is defined here to represent a measurable and technically defensible change in the condition of a water body within which it has been measured. Most commonly

this is termed “incremental improvement” in which the condition of a water body that does not yet fully meet all applicable water quality standards (WQS) can be tracked as to the direction or trajectory of any changes. The general principles of incremental change are defined as follows (after Yoder and Rankin 2008):

- **Measurement of incremental change** can be accomplished in different ways, provided the measurement method is scientifically sound, appropriately used, and sufficiently sensitive enough to generate data from which signal can be discerned from noise;
- **Measurable parameters and indicators** of incremental change include biological, chemical, and physical properties or attributes of an aquatic ecosystem or pollution source that can be used to reliably indicate a change in condition; and,
- **A positive change in condition** means a measurable improvement that is related to a reduction in a specific pollutant load, a reduction in the number of impairment causes, a reduction in an accepted non-pollutant measure of degradation, or an increase in an accepted measure of waterbody condition relevant to designated use support.

This was accomplished for this study by comparing the results of prior, comparable assessments. In this case there has been a series of bioassessments beginning in 1979 by Ohio EPA (Yoder et al. 1981) which serves as the pre-water quality-based pollution control baseline against which subsequent results after 1988 are compared to assess incremental changes in key parameters and indicators. Subsequent to 1979, sufficient data was available from the intervening years to inform a detailed demonstration of incremental change. Historical biological and chemical data from the late 1960s and early 1970s was also accessed and is part of the analysis of key chemical parameters and the macroinvertebrate assemblage.

Biological Methods

All biological sampling methods are defined by the applicable protocols published by the Ohio EPA (1987a,b; 1989a,b; 2006, 2015a,b). These meet the specifications of the Ohio WQS and are used to assess aquatic life and recreational use designations, to determine the extent and severity of impairments, and to document incremental changes that result from pollution abatement actions.

Fish Assemblage Methods

Methods for the collection of fish at wadeable sites was performed using a tow-barge or long-line pulsed D.C. electrofishing equipment based on a T&J 1736 DCV or Smith-Root 2.5 GPP electrofishing unit described by Ohio EPA (1989a). A Wisconsin DNR ETS AbP-3 battery powered backpack electrofishing unit was used as an alternative to the long line in the smallest headwater streams and in accordance with the restrictions on the use of backpack units described by Ohio EPA (1989a). A three person crew carried out the sampling protocol for each type of wading equipment. Sampling effort was indexed to lineal distance ranging from 150-200 meters in length for headwater and smaller wadeable sites and increased to 300 meters in the Olentangy River mainstem sites that were too shallow to sample with non-wadeable gear and which are at the upper boundary of drainage area for wadeable methods. Sampling

distance was measured with a Global Positioning System (GPS) unit or laser range finder. Sampling locations were delineated using the GPS mechanism and indexed to latitude/longitude and Universal Transverse Mercator (UTM) coordinates at the beginning, end, and mid-point of each site. The location of each sampling site was indexed by river mile using the Ohio EPA River Mile Index (RMI) system⁶. Sampling was conducted during a June 16-October 15 seasonal index period two times at the larger wadeable sites and once at headwater sites draining <20 square miles. Sampling was conducted in a general upstream direction and in and adjacent to the most heterogeneous habitat. Stunned fish were collected by a primary and one secondary netter with the third crew member tending the electrofishing unit and tow barge or long line. Non-wadeable sites were sampled two times with a boat or raft-mounted pulsed D.C. electrofishing device. A Smith-Root 5.0 GPP unit was mounted on a 16' Wing raft or a 16' john boat with an electrode array in keeping with Ohio EPA (1989a) design specifications. Boat and raft sampling were conducted in a general downstream direction. A bow netter collected most fish with a secondary netter positioned behind the live well. Sampling effort for this method is 500 meters and conducted during a June 16-October 15 seasonal index period two times at all sites.

Samples from each site were processed by enumerating and recording weights by species and in some cases by life stage (y-o-y, juvenile, adult). All captured fish were immediately placed in an aerated live well (boat, raft, tote barge) or floating live net (long line and backpack) for processing. Water was replaced and/or aerated regularly to maintain adequate dissolved oxygen levels in the water and to minimize handling mortality. Fish not retained for voucher or other purposes were released back into the water after they had been identified to species, examined for external anomalies, and weighed. Weights were recorded at boatable and large wadeable >20 square mile sites only. Larval or post-larval stage individuals measuring less than 15-20 mm in length (excluding species with small size as adults) were generally not included in the data as a matter of practice. The two mixing zone sites were 100 meters long and located directly in the effluent plumes of the Jackson Pike and Columbus Southerly WWTP outfalls.

The incidence of external anomalies was recorded following procedures outlined by Ohio EPA (1989a; 1996) and refinements made by Sanders et al. (1999). While the majority of captured fish were identified to species in the field, any uncertainty about the field identification of individual fish required their preservation for later laboratory identification. Vouchers were preserved in borax buffered 10% formalin and labeled by date, river or stream, and geographic identifier (e.g., river mile). Identification was to the species level at a minimum and to the sub-specific level if necessary. A number of regional ichthyology keys were used and included the Fishes of Ohio (Trautman 1981). Vouchers were deposited at and verified by The Ohio State University Museum of Biodiversity (OSUMB). Data were recorded on water resistant data forms for entry into the MBI ECOS data management system with all entries proofread for accuracy.

Macroinvertebrate Assemblage Methods

Macroinvertebrates were sampled using modified Hester-Dendy artificial substrate samplers

⁶ <https://data-oepra.opendata.arcgis.com/apps/river-miles-index/explore>

(quantitative sample) and a qualitative dip net/hand pick method in accordance with Ohio EPA macroinvertebrate assessment procedures (Ohio EPA 1989a, 2015a). The artificial substrates were exposed for a colonization period of six weeks and placed to ensure adequate stream flow over the substrates. Samplers were set where flow is >0.3 feet/second over the plates whenever possible. A qualitative sample using a triangular frame dip net and hand picking was collected at the time of artificial substrate retrieval and initially preserved in 95% ethanol. Artificial substrate samples were initially preserved in a 10% solution of formaldehyde, then transferred to the laboratory, disassembled, sieved (standard no. 30 and 40), and transferred to 70% ethyl alcohol. Laboratory sample processing of the quantitative samples included an initial scan and pre-pick for large and rare taxa followed by subsampling procedures in accordance with Ohio EPA (1989a, 2015a). Identifications were performed to the lowest taxonomic resolution possible for the commonly encountered orders and families, which is genus/species for most taxa. From these results, the density of macroinvertebrates per square foot was determined as well as a taxonomic richness and the Invertebrate Community Index (ICI; Ohio EPA 1987b; DeShon 1995) score for the quantitative samples and a narrative assessment for standalone qualitative samples that is employed in headwater streams draining <10 square miles.

Trajectories in Key Indicators

Developing an understanding of the temporal trajectory of the different indicators and parameters that are provided by a spatially adequate monitoring design is important feedback to Columbus DOSD, Ohio EPA, and stakeholders in the Scioto and Olentangy River study area. The study area has a complex mosaic of watershed level and site-specific impacts the complexity of which makes being able to understand and then develop management responses to impairments an immense challenge. The documentation of incremental improvement as opposed to a singular focus on the full restoration of impairments allows program effectiveness to receive credit short of achieving full restoration. Furthermore, failing to recognize if waters are improving and on a positive trajectory can lead to erroneous conclusions about the attainability of CWA goals and the viability of restoration efforts. Simply put, a selective focus on individual and selected pollutants alone is insufficient in a complex setting like the 2022 study area. It is for these reasons that being able to detect, measure, and express incremental improvements in key indicators is vital. Showing incremental progress not only provides confirmation that restoration efforts are working, it also provides important feedback for those programs which because of uncertainties in their control must be adaptive in order to succeed. As such, the type of monitoring and assessment that was employed in this survey was designed to provide results that could be used to demonstrate the degree and direction of incremental change.

The results of the bioassessment using the primary indices that comprise the Ohio biocriteria were used to quantify the degree to which overall aquatic life conditions have improved through time up to and including the 2022 survey. The Area of Degradation (ADV) and Area of Attainment (AAV) methodology (Yoder et al. 2005) was used to illustrate the degree of change between the Ohio EPA surveys of the Scioto and Olentangy River mainstems, the MBI surveys of 2015, and the DOSD surveys of 2020 and 2022. The ADV/AAV term is an expression of the

degree to which one of the biological index values is either above or below the WWH biocriterion and the distance of the mainstem over which it occurs. As such it is a quantification of the “quantity” of biological attainment and impairment. When normalized to a standard distance (e.g., per mile) it can be an effective indicator of the degree of change which is taking place between river reaches and through time in the same river reach and between different rivers.

Area of Degradation and Attainment Values

The ADV (Yoder and Rankin 1995b) was originally developed to quantify the extent and severity of departures from a biocriterion within a defined river reach. For reaches that fail to attain the applicable biocriterion it is expressed as the Area of Degradation Value (ADV; Yoder and Rankin 1995a, Yoder et al. 2005). For reaches that meet a biocriterion it is expressed as the Area of Attainment Value (AAV) that quantifies the extent to which minimum attainment criteria are surpassed (Yoder et al. 2005). The ADV/AAV correspond to the area of the polygon formed by the longitudinal profile of an index score and the straight line boundary formed by the applicable biocriterion, the ADV below and the AAV above. The computational formula (after Yoder et al. 2005) is:

$$\text{ADV/AAV} = \sum [(aIBI_a + aIBI_b) - (pIBI_a + pIBI_b)] * (RMA - RMB), \text{ for } a = 1 \text{ to } n, \\ \text{where;}$$

aIBI_a = actual IBI at river mile a,
 aIBI_b = actual IBI at river mile b,
 pIBI_a = IBI biocriterion at river mile a,
 pIBI_b = IBI biocriterion at river mile b,
 RMA = upstream most river mile,
 RMB = downstream most river mile, and
 n = number of samples.

The average of two contiguous sampling sites is assumed to integrate biological assemblage status and response over the distance between the points. The intensive pollution survey design typically positions sites in close enough proximity to sources of stress and along probable zones of impact and recovery such that meaningful changes are adequately captured and individual results are not over extrapolated. Biological assemblages as portrayed by their respective indices will change predictably in proximity to major sources and types of pollution (Ohio EPA 1987; Yoder and Rankin 1995; Yoder and Smith 1999; Yoder et al. 2005; Yoder et al. 2019). Thus, the longitudinal connection of contiguous sampling points produces a reasonably accurate portrayal of the extent and severity of impairment in a specified river reach as reflected by the biological indices (Yoder and Rankin 1995a,b; Yoder et al. 2005; Yoder et al. 2019).

The total ADV/AAV for a specified river segment is normalized to ADV/AAV units/mile for making comparisons between years and rivers. The ADV is calculated as a negative (below the biocriterion) expression; the AAV is calculated as a positive (above the biocriterion) expression.

Each depicts the extent and degree of impairment (ADV) and attainment (AAV) of a biological criterion, which provides a more quantitative depiction of quality than do simple pass/fail descriptions. It also allows for the visualization of incremental changes in condition that may not alter the pass/fail status, but are nonetheless meaningful in terms of change over space and time. In these analyses, the Warmwater Habitat (WWH) biocriterion for the fish and macroinvertebrate indices, which vary by use designation and ecoregion, were used as the threshold for calculating the ADV and AAV for the Scioto and Olentangy River mainstems. The WWH use designation represents the minimum goal required by the Clean Water Act (CWA) for the protection and propagation of aquatic life, thus it is used as a standard benchmark for the ADV/AAV analyses.

Habitat Assessment

Physical habitat was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989, 1995; Ohio EPA 2006). Various attributes of the habitat are scored based on the overall importance of each to the maintenance of viable, diverse, and functional aquatic assemblages. The type(s) and quality of substrates, amount and quality of instream cover, channel morphology, extent and quality of riparian vegetation, pool, run, and riffle development and quality, and gradient are some of the metrics used to determine the QHEI score which generally ranges from 20 to less than 100. The QHEI is also used to evaluate the characteristics of a stream or river segment, as opposed to the solely assessing the characteristics of a single sampling site. As such, individual sites may have poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of segments around the state have indicated that values greater than 60 are generally conducive to the existence of warmwater faunas whereas scores less than 45 generally cannot support a warmwater assemblage (Ohio EPA 1989b, Rankin 1995) consistent with baseline CWA goal expectations (e.g., the WWH in the Ohio WQS).

Chemical/Physical Methods

Chemical/physical assessment for the 2022 study area included the collection and analysis of water samples for chemical/physical and bacterial analysis and sediment samples for determining sediment chemical quality. Methods for the collection of water column chemical/physical and bacterial samples followed the procedures of Ohio EPA (2019a,b). Sediment chemical sampling followed that described by Ohio EPA (2019c). All laboratory analyses except benthic and sestonic chlorophyll *a* was performed by the Columbus DOSD Surveillance Laboratory. Sestonic chlorophyll *a* analysis was performed by Alloway Laboratories located in Marion, OH and the biomass of chlorophyll *a* in benthic algae was analyzed by the University of Washington Marine Sciences Laboratory, Seattle, WA.

Water Column Chemical Quality

Water column chemical quality was determined by the collection and analysis of grab water

samples, instantaneous measurements recorded with a water quality meter, and continuous measurements recorded at multiple day intervals at selected sites in the Scioto and Olentangy River mainstem.

Grab Sampling

Grab samples of water were collected with a stainless steel bucket from a location as close to the center point of the stream channel as possible by the MBI sampling crew. Samples were collected from the upper “12-24” of the surface and then transferred to sample containers in accordance with Ohio EPA (2019a,b) procedures. Sampling was conducted between mid-June and mid-October and under “normal” summer-fall low flows – elevated flows following precipitation events were avoided and sampling was delayed until the elevated flows subsided. The frequency of sampling ranged from six (6) times at mainstem sites and four (4) times at Olentangy tributary sites. Instantaneous values for temperature (°C), conductivity (µS/cm), pH (S.U.), and dissolved oxygen (D.O.; mg/L) were recorded with a YSI Model 664 meter at the time of grab sample collections.

Continuous Recordings

Continuous readings of temperature (°C), conductivity (µS/cm), pH (S.U.), and dissolved oxygen (D.O.; mg/L) were recorded with YSI EXO 2 and EXO3 Sonde (“Datasonde”) instruments at 32 Scioto and Olentangy mainstem locations. The Datasondes were set as close as possible to the Thalweg (i.e., deepest part of the stream channel) in a PVC enclosure that ensured no contact with the stream bottom or other solid objects. The Datasondes were positioned vertically where depth allowed by driving steel fence posts into the bottom and positioning the PVC enclosure in an upright position. Where the depth was too shallow or deep, the PVC enclosure was secured in a horizontal position in an area of the stream channel with continuous flow. All Datasondes were secured against theft or vandalism. “Short-term” deployments were made over 4-5 day continuous intervals during periods of maximum summer temperatures and normal summer flows. Readings were recorded at 15 minute intervals. At the time of retrieval data was downloaded to a YSI Model 650 Instrument with high memory capacity and then transferred to a PC for storage and later analysis. “Long term” deployments were made during July, August, and September 2022 at three (3) sites in the Scioto River mainstem and a single site in the Olentangy River to better understand how representative the short-term data actually is. Data collected by USGS at Shadeville was also accessed for the same purpose.

Sediment Chemical Quality

Fine grain sediment samples were collected in the upper strata of bottom material at each sampling location using decontaminated stainless steel spoons and excavated using nitrile gloves. Decontamination of sediment sampling equipment followed the procedures outlined in the Ohio EPA sediment sampling guidance manual (Ohio EPA 2019c). Grab samples were homogenized as a composite in stainless steel pans (material for VOC analysis was not homogenized), transferred into glass jars with Teflon® lined lids, placed on ice (to 4°C) in a cooler, and delivered to the Columbus DOSD Surveillance Lab. Sediment data was reported on a dry weight basis. Sediment samples were analyzed for a total analyte list of inorganics (metals),

nutrients, volatile organic compounds, semi-volatile organic compounds, PCBs, total petroleum hydrocarbons, and cyanide.

Determining Use Attainment Status

Use attainment status is a term which describes the degree to which environmental parameters or indicators are either above or below criteria specified by the Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1). For the 2022 study area two use designations were evaluated, aquatic life and recreation in and on the water by humans. Hence the process herein is referred to as the determination of aquatic life and recreational status for each sampling site. The process was applied to data collected by ambient assessments and applies to ambient locations outside of discharger mixing zones.

Aquatic Life Use Attainment Status

Aquatic life use attainment status is determined by the Ohio EPA biological criteria (OAC 3745-1-07; Table 7-17). Numerical biological criteria are based on multimetric biological indices which include the Index of Biotic Integrity (IBI) and modified Index of Well-Being (MIwb), which indicate the health and well-being of the fish assemblage, and the Invertebrate Community Index (ICI), which indicates the quality of the macroinvertebrate assemblage. The IBI and ICI are multimetric indices patterned after an original IBI described by Karr (1981), Fausch et al. (1984), and Karr et al. (1986) and subsequently modified by Ohio EPA (1987b) for application to Ohio rivers and streams. The ICI was developed by Ohio EPA (1987b) and was further described by DeShon (1995). The MIwb is a measure of fish community abundance and diversity using numbers and weight information and is a modification of the original Index of Well-Being originally applied to fish community information (Gammon 1976; Gammon et al. 1981). Numerical biocriteria are stratified by ecoregion, use designation, and stream or river size per OAC 3745-1-07(C). Three attainment status results are possible at each sampling location - full, partial, or non-attainment as follows:

- **FULL** attainment means that all of the indices meet the applicable biocriteria.
- **PARTIAL** attainment means that one or more of the indices fails to meet the applicable biocriteria.
- **NON**-attainment means that none of the indices meet the applicable biocriteria or one of the organism groups reflects poor or very poor quality.

An aquatic life use attainment table is constructed based on the sampling results and is arranged from upstream to downstream and includes the sampling locations indicated by site code, river mile, the applicable biological indices, the use attainment status (*i.e.*, full, partial, or non), the Qualitative Habitat Evaluation Index (QHEI) score, and pertinent comments and observations about each sampling location and proximity to sources of stress.

Recreation

Criteria for determining attainment of recreational uses are established in the Ohio Water Quality Standards (OAC 3745-1-07; Table 7-13) based upon the counts of fecal bacteria

Escherichia coli) present in the water column expressed as colony forming units (cfu) per 100 mL. *Escherichia coli* (*E. coli*) bacteria are microscopic organisms that are normally present in the feces and intestinal tracts of humans and other warm-blooded animals. *E. coli* typically comprises approximately 97 percent of the organisms found in the fecal coliform bacteria of human feces (Dufour 1977). There is currently no easy way to differentiate between human and animal sources of fecal coliform bacteria in surface waters, although methodologies for this determination include DNA analysis. These microorganisms can enter water bodies where there is a direct discharge of human and/or animal wastes, or they may enter water bodies via runoff from soils where such wastes have been deposited. Pathogenic (disease-causing) organisms are typically present in the environment in such small amounts that it is impractical to directly monitor each specific type of pathogen. Fecal indicator bacteria by themselves, including *E. coli*, are generally not pathogenic. However, some strains of *E. coli* can be pathogenic, being capable of causing serious illness. Although not necessarily agents of disease, fecal indicator bacteria such as *E. coli* may signal the *potential* presence of pathogenic organisms that can enter the aquatic environment via the same pathways. When *E. coli* are present in extremely high numbers in a water sample, it invariably means the water has received fecal matter from one or more sources of raw sewage that are likely human in origin.

The Ohio WQS for recreational uses were revised in 2016 to reflect a more rigid adherence to any form of contact with surface waters as ensuing the same level of risk. This replaced the former framework that was stratified to account for the degree of contact with three (3) subcategories of the Primary Contact Recreational (PCR) use as PCR-A, PCR-B, and PCR-C. Those subcategories are now merged into a single use. The application of the Secondary Contact Recreational (SCR) use was also changed to a more restrictive interpretation of the potential for human contact with surface waters. Existing SCR designations remain, but could potentially be reviewed and revised to PCR by Ohio EPA. Any new SCR recommendations would need to document that there is no human contact possible due to impermeable physical restrictions to access a surface water. As a result the evaluation of the recreational uses in the 2022 study area were done in accordance with the existing designations of PCR and SCR as applicable.

Streams in the Scioto River basin are designated as Primary Contact Recreation (PCR) and/or Secondary Contact Recreation (SCR) use in the Ohio WQS (OAC 3745-1- 09). Water bodies with a designated recreation use of PCR “. . . are suitable for one or more full-body contact recreation activities such as, but not limited to, wading, swimming, boating, water skiing, canoeing, kayaking, and scuba diving” (OAC 3745-1- 07(B)(4)(b)). SCR includes waters that “. . . result in minimal exposure potential to water borne pathogens because the waters are; rarely used for water based recreation such as, but not limited to, wading; situated in remote, sparsely populated areas; have restricted access points; and have insufficient depth to provide full body immersion, thereby greatly limiting the potential for water based recreation activities.”

The *E. coli* criterion that applies to PCR is expressed as a 90-day geometric mean of ≤ 126 colony forming units (cfu)/100 mL with a Statistical Threshold Value of 410 cfu/100 mL⁷. The criterion

⁷ These criteria shall not be exceeded in more than ten per cent of the samples taken during any ninety-day period.

that applies to SCR designated streams is $\leq 1,030$ cfu/100 mL for both the 90-day geometric mean and the STV. An arithmetic mean based on two or more samples can be used as the basis for determining the attainment status of the PCR use.

Determining Use Attainability

Use designation reviews and recommendations for revisions, whenever necessary, have been a consistent focus of prior Ohio EPA biological and water quality assessments conducted throughout the Scioto River basin. Given the status of the 2015, 2020, and 2022 data as Level 3 credible data, it is eligible to be used by Ohio EPA to revise certain use designations. The use attainment tables are based on the most applicable of the existing use designation or a recommended use designation, particularly for sites that are attaining the recommended designation. Many of the outstanding use designation changes had been made following the Ohio EPA assessments of the 1980s and 1990s, but recent dam removals have opened certain mainstem reaches to reconsideration from their current Modified Warmwater Habitat (MWH) use designations based on the failure to meet the WWH biocriteria due to the habitat alterations imposed by the now removed impoundments in the Olentangy and Scioto mainstems. The improvement in the Scioto River downstream from Big Walnut Creek in 2015 and 2020 led to redesignation as Exceptional Warmwater Habitat (EWH) in 2022.

Determining Causal Associations

Using the results, conclusions, and recommendations of this report requires an understanding of the methodology used to determine biological status (i.e., unimpaired or impaired, narrative ratings of quality) and assigning associated causes and sources of impairment utilizing the accompanying chemical/physical data and source information (e.g., point source loadings, land use). The identification of impairment in rivers and streams is straightforward - the numerical biological indices are the principal arbiter of aquatic life use attainment and impairment per OAC 3745-1-07[C]. The rationale for using the biological results in the role as the principal arbiter within a weight of evidence framework has been extensively discussed elsewhere (Karr et al. 1986; Karr 1991; Ohio EPA 1987a,b; Yoder 1991; Yoder 1995). Describing the causes and sources associated with observed biological impairments relies on an interpretation of multiple lines of evidence including the water chemistry data, sediment data, habitat data, effluent data, land use data, and biological response signatures (Yoder and Rankin 1995b; Yoder and DeShon 2003). Thus the assignment of associated causes and sources of biological impairment in this assessment represents the association of impairments (based on response indicators) with stressor and exposure indicators using linkages to the bioassessment data based on previous experiences within the experience with analogous situations and impacts. For example, exceedances of established chemical thresholds such as chronic and acute water quality criteria or sediment effect thresholds are grounds for listing such categories of parameters to include individual pollutants provided that they co-occur with a biological impairment.

Hierarchy of Water Indicators

A carefully conceived ambient monitoring approach, using cost-effective indicators comprised

Completing the Cycle of WQ Management: Assessing and Guiding Management Actions with Integrated Environmental Assessment

Indicator Levels

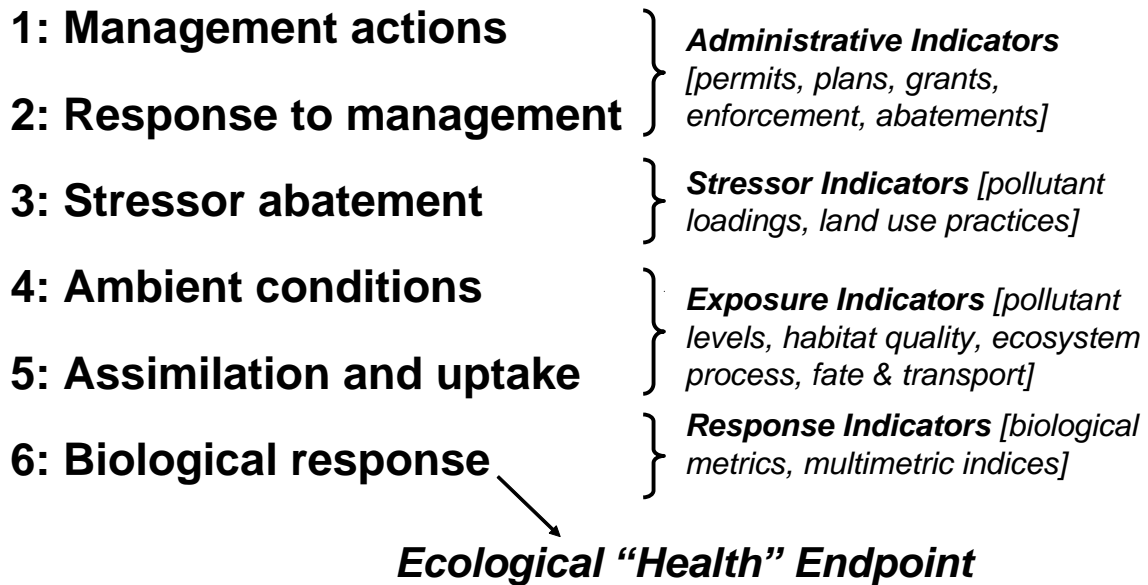


Figure 5. Hierarchy of administrative and environmental indicators which can be used for water quality management activities such as monitoring and assessment, reporting, and the evaluation of overall program effectiveness. This is patterned after a model developed by U.S. EPA (1995a,b) and further enhanced by Karr and Yoder (2004).

of ecological, chemical, and toxicological measures, can ensure that all pollution sources are judged objectively on the basis of environmental results. A tiered approach that links the results of administrative actions with environmental measures was employed in the analyses and within the limitations of the data that is available for certain sources. This integrated approach is outlined in Figure 4 and includes a hierarchical continuum from administrative to true environmental indicators. The six “levels” of indicators include:

1. Actions taken by regulatory agencies (permitting, enforcement, grants);
2. Responses by the regulated community (treatment works, pollution prevention);
3. Changes in discharged quantities (pollutant loadings);
4. Changes in ambient conditions (water quality, habitat);
5. Changes in uptake and/or assimilation (tissue contamination, biomarkers, assimilative capacity); and, changes in health, ecology, or other effects (ecological condition, pathogens).

In this process the results of administrative activities (levels 1 and 2) can be linked to efforts to improve water quality (levels 3, 4, and 5) which should translate into the environmental “results” (level 6). An example is the aggregate effect of billions of dollars spent on water pollution control since the early 1970s that have been determined with quantifiable measures of environmental condition (Yoder et al. 2005). Superimposed on this hierarchy is the concept of stressor, exposure, and response indicators. *Stressor* indicators generally include activities which have the potential to degrade the aquatic environment such as pollutant discharges (permitted and unpermitted), land use effects, and habitat modifications. *Exposure* indicators are those which measure the effects of stressors and can include whole effluent toxicity tests, tissue residues, and biomarkers, each of which provides evidence of biological exposure to a stressor or bioaccumulative agent. *Response* indicators are generally composite measures of the cumulative effects of stress and exposure and include the more direct measures of community and population response that are represented here by the biological indices which comprise the Ohio EPA biological endpoints. Other response indicators can include target assemblages, *i.e.*, rare, threatened, endangered, special status, and declining species or bacterial levels that serve as surrogates for the recreational uses. These indicators represent the essential technical elements for watershed-based management approaches. The key, however, is to use the different indicators *within* a strict adherence to the roles which are most appropriate for each (Yoder and Rankin 1998).

STUDY AREA DESCRIPTION

The Scioto River basin drains 6,517 mi.² and is the second largest watershed contained entirely within Ohio (16% of all land area). The mainstem is 231 miles in length (Ohio DNR 1960) originating in Auglaize Co. in north central Ohio and entering the Ohio River at Portsmouth in Scioto Co. The river has the longest length of unimpounded, free-flowing riverine habitat in Ohio, being open from the Greenlawn Dam in Columbus to the confluence with the Ohio River, a distance of 129.8 miles. The geology of the basin transitions from the glaciated Eastern Corn Belt Plains to the unglaciated Western Allegheny Plateau ecoregion (Omernik 1987; Woods et al. 1998) just south of Chillicothe. The mainstem and several of its tributaries were formed within outwash valleys after the Wisconsinan age of glaciation. As a result, the Scioto River and its tributaries have continuous base flows comprised of groundwater inputs and contained in coarse substrates of gravel and cobbles with slab boulders at points along the mainstem where outcroppings of Devonian limestone occur. The climate is temperate with four (4) distinct seasons (spring, summer, autumn, winter) and 39.7 inches of average annual precipitation which includes an average of 32 inches of annual snowfall. The elevation at Columbus is 781 feet above mean sea level. The Olentangy River was originally called *keenhongsheconseung*, a Delaware word literally translated as "sharp tool river" presumably due to its shale bedrock that yielded stone tools and spears. Originally translated to Whetstone River, it was later named Olentangy. It is 97 miles in length originating in Morrow County flowing northwest towards Bucyrus, where it turns south and flows through Marion County flowing south into Delaware County and southward into Franklin County where it enters the Scioto River in downtown Columbus. Twenty-two (22) miles of the mainstem is designated as a State Scenic River.

The Scioto River valley was originally home to several aboriginal cultures and the name Scioto is derived from the Wyandot word *skenq·tq'* (deer). Permanent European settlement was initiated after the American Revolution in the late 1700s and early 1800s displacing the aboriginal populations soon thereafter. Of the 11 major cities that now border the Scioto River, the city of Columbus has the largest population. When Columbus was chartered in 1834, the population was 3,500. That population grew rapidly after 1900, and especially through the latter half of the 20th century, reaching just over two (2) million persons in 2015 across the greater metropolitan region. Unlike many of the larger cities in Ohio and neighboring states, Columbus lacks heavy industry and as the state capitol the economic base is comprised mostly of government and non-industrial businesses. The Scioto River serves as the principal water supply for the Columbus metropolitan area with two public water supply reservoirs, Griggs and O'Shaughnessy, located on the mainstem and two others (Alum Creek and Hoover reservoirs) on major Scioto River tributaries in the Big Walnut Creek watershed to the northeast of Columbus. An upground reservoir in southern Delaware County and wells in southern Franklin County provide the balance of the public water supply.

Current Pollution Sources and Other Stressors

Pollution sources and general stressors are typical for a non-industrialized urbanized setting like the greater Columbus metropolitan area. Major pollution sources include major permitted discharges of municipal wastewater (Table 7), discharges from combined and sanitary sewer

Table 7. List of major NPDES permitted discharges in the 2022 Scioto and Olentangy River study area showing their location and receiving water body, current NPDES permit effective and expiration dates, 2016-22 third quarter (July 1-September 30) average discharged flows, effluent totals for the Scioto and Olentangy Rivers, the proportion of effluent at the Q_{7,10} and 80th percentile river flows, wet weather capacity, treatment type, number of CSOs, and nutrient removal or monitoring.

Facility	Receiving Waterbody	NPDES ID	Effective Date	Expiration Date	RM	2016-22 Avg. 3rd Quarter	Avg. Design Flow	Wet Weather Flow	Treatment Type ¹	CSOs	Nutrient Removal ³
1 - Jackson Pike WWTP	Scioto River	4PF00000	11/16/2021	12/31/2026	127.10	69.31	68.00	150	AWT	30	M
2 - Southerly WWTP	Scioto River	4PF00001	1/1/2022	12/31/2026	118.30	95.82	114.00	330	AWT	1	M
3 - Commercial Point WWTP	Scioto River	4PC00101	10/1/2019	9/30/2024	115.35	0.26	0.43	na	AWT	na	M
4 - South Bloomfield WWTP	Scioto River	4PB00107	3/1/2019	2/29/2024	109.29	0.17	0.50	na	AWT	na	M
5 - Circleville WWTP	Scioto River	4PD00003	9/1/2019	8/31/2024	99.20	0.28	4.00	na	Secondary	na	M
6- Olentnagy ECC WWTP	Olentnagy River	4PK00001	8/1/2023	7/31/2028	13.50	3.40	6.00	24	AWT ²	na	1.0 mg/L
						Effluent Flow Totals ⁴	165.84	186.93			
						⁵ Proportion Q _{7,10}	261%	295%			
						⁶ Proportion 80th %ile	160%	181%			

¹ - AWT = Advanced Wastewater Treatment (BOD₅ 10/12 mg/L [monthly avg./weekly avg.]; NH₃-N 1.0/1.5 mg/L); ² - OECC AWT (BOD₅ 8.5/12.8 mg/L [monthly avg./weekly avg.]; NH₃-N 0.78/1.18 mg/L); total P 1.0 mg/L; ³ - M = monitoring only; ⁴ - Scioto River mainstem discharges only - excludes Olentnagy ECC; ⁵ - USGS Gage 03227500 May-Nov. Q_{7,10} = 98 cfs (63.34 MGD); ⁶ - 80%ile flow = 160 cfs (103.41 MGD).

overflows (CSO and SSO), minor permitted discharges, other releases from industrial facilities, and general urban runoff and its associated chemical pollution, hydrological alterations, and direct and indirect habitat alterations.

Adding to the challenges of managing the largest pollution source in the form of the municipal sewerage system, the Columbus metropolitan area is experiencing the fastest population growth of any major city in the Midwest U.S. The population increased by more than 230,000 persons during 2010 to 2020, a 12.2% increase (U.S. Census Bureau 2020). The population is projected to grow by another 500,000 persons through 2050 under current trends. As would be expected this will place significant capacity demands on the sewerage system infrastructure and treatment facilities as well as demands on the remaining assimilative capacity of the receiving rivers and streams.

Ohio EPA (2012) listed 42 point source discharges in the Middle Scioto River basin that hold National Pollutant Discharge Elimination System (NPDES) permits. Of this total, only three are classified as major discharges, the Jackson Pike WWTP (discharge at RM 127.1), the Southerly WWTP (discharge at RM 118.3), and the Circleville WWTP (discharge at RM 99.2; Figure 1). Two smaller facilities discharge to the Scioto River mainstem and include the Commercial Point and South Bloomfield WWTPs. Together the Jackson Pike and Southerly WWTPs can discharge approximately 182 MGD of treated wastewater that comprises a dominant proportion of the flow in the Scioto River mainstem during dry weather periods. Dry weather plant bypasses that were frequent, especially at Southerly, in the 1970s and early 1980s were virtually eliminated by the composting of sewage sludge. The later addition of expanded wet weather storage and treatment capacity and increasing interceptor sewer storage ahead of the WWTPs further reduced wet weather related bypasses and overflows. The total of average third quarter (July 1-September 30) WWTP flows during the 2016-22 period was 257% of the May-November $Q_{7,10}$ critical low flow and 158% of the May-November 80th percentile flow (Metzker and Johnson 1981) measured at the Columbus USGS gage (03227500) located just upstream from the Jackson Pike WWTP. The Delaware Co. Olentangy Environmental Control Center (ECC) WWTP is the only major discharge to the lower Olentangy River mainstem (discharge at RM 13.50) in southern Delaware Co. The design flow of 6.0 MGD comprises 54.5% of the $Q_{7,10}$ flow measured at the Worthington USGS gage (03226800) located downstream from I-270.

City of Columbus Sewerage System

The City of Columbus collects and treats residential and industrial sanitary wastewater from the city and most of the surrounding suburbs. The collection system that conveys wastewater to one of the treatment plants is comprised of 163 miles of combined sewers and 4,641 miles of separate sanitary sewers that transport wastewater to one of the two major treatment plants, Jackson Pike or Southerly. The Jackson Pike Wastewater Treatment Plant (WWTP) serves the western half of Franklin County and the central portion of Columbus. The Southerly WWTP is responsible for treating wastewater from the eastern and southern portions of Franklin county. The combined sewer system was the standard at the time it was built being designed to carry both rain water and sewage to the Jackson Pike WWTP. It is located mostly in the older sections of the city, such as downtown and the OSU campus area. The stormwater collection system

consists of an additional 3,818 miles of piping. This system collects rain water and snow melt runoff that enter the storm sewer system through drainage ditches or via drains on curbed streets. Any materials on the surface of streets, roofs, sidewalks, and yards can be washed into the storm sewer system, which empties directly into nearby streams or rivers with no treatment. Descriptions of the two major WWTPs and other initiatives to abate pollution delivered by the sewer system are described as follows.

Jackson Pike WWTP (Scioto River RM 127.1)

The Jackson Pike WWTP is located in south Columbus discharging to the Scioto River mainstem at RM 127.1 just downstream from Frank Rd. and St. Rt. 104. It is the site of the first wastewater treatment plant that was originally constructed in 1904. The facility has been subjected to multiple upgrades with advanced wastewater treatment in 1988 and capacity and other treatment upgrades since. Based on the most recent NPDES permit fact sheet⁸ the Jackson Pike WWTP was constructed in 1935 and last upgraded in 2010. The average design flow is 68.0 million gallons per day (MGD). In 2010, the wet weather treatment capacity increased to 150 MGD as part of the implementation of the Wet Weather Management Plan. The Jackson Pike WWTP serves the city of Columbus, neighboring cities, villages, and township areas in Franklin, Delaware, and Union counties. The service population projected for 2014 was over 1.3 million persons. The Jackson Pike plant offers advanced wastewater treatment with summer effluent limits of 10/12 mg/L BOD₅ and 1.0-1.5 mg/L ammonia-N. There are two bypasses at the Jackson Pike plant - station 002 (gravity flow at wet well) and Station 003 (pumped flow at the head works). Bypassed flows do occur, but are minimal in terms of flow and loadings. The facility has an approved industrial pretreatment program with 19 categorical industrial users and 12 significant non-categorical industrial users discharging 2.65 MGD to the WWTP (Columbus DOSD 2024). Columbus has 30 CSO locations on the Scioto and lower Olentangy rivers between the Olentangy River confluence at RM 132.3 and the Whittier Street CSO (RM 129.3) that are listed in the Jackson Pike WWTP NPDES permit. These are currently being addressed by a variety of measures including reducing the infiltration of precipitation into the sewer system via Blueprint Columbus. The OSIS (Olentangy Scioto Interceptor Sewer) Augmentation Relief Sewer (OARS)⁹ is a sewer tunnel project done in response to a Consent Decree for Columbus to develop a Long Term Control Plan (LTCP) in compliance with the requirements of the U.S. EPA CSO Control Policy of 1994 to reduce and eliminate discharges from combined sewer overflows (CSOs). By design OARS intercepts wet weather overflows that formerly discharged to the Scioto River sending these flows to Jackson Pike (and Southerly) via a tunnel that lies 170 feet beneath the surface. OARS, a 23,300 feet long 20-foot diameter tunnel, in service since July 2017, provides relief to the existing OSIS trunk sewer from just north of the Arena District to the Jackson Pike WWTP. The result has been zero discharges from the CSOs at Whittier Street and Liberty Street north of Short Street, , and the Whittier Street Standby Storm Tanks inlet gates were closed on February 9, 2018. OARS Tunnel mitigated the Downtown CSOs to a 10-yr level of service. The Lower Olentangy Tunnel (LOT - OARS Phase II) is currently underway and will mitigate the remaining CSOs to the typical year level of service to

⁸ Jackson Pike WWTP Fact Sheet https://www.epa.ohio.gov/dsw/permits/npdes_info

⁹ <https://www.columbus.gov/Templates/Detail.aspx?id=75100#>

the lower four miles of the Olentangy River and Scioto River just downstream from the confluence

Southerly WWTP (Scioto River RM 118.3)

The Southerly WWTP is located in southern Franklin Co. discharging to the Scioto River mainstem at RM 118.3 just over one mile upstream from the confluence with Big Walnut Creek. The facility was constructed in 1967 and last upgraded in 2010. The average design flow is 114 million gallons per day (MGD). In 2010, the wet weather treatment capacity was increased to 440 MGD as part of the implementation of the Wet Weather Management Plan (WWMP) and Chemically Enhanced Primary Treatment (CEPT). The collection system is 99 percent separate sewers and 1 percent combined. The single CSO located on Alum Creek, which is in the tributary network of Big Walnut Creek, is listed in the Southerly WWTP permit. A raw sewage bypass is located at the head works (outfall 002) and it could become active during severe wet weather. Bypasses were recorded on only 20 days during 2010-15. The Southerly WWTP has an approved industrial pretreatment program consisting of 21 categorical industrial and 22 significant non-categorical industrial users discharging 2.682 MGD to the plant (Columbus DOSD 2024).

Blueprint Columbus

The original WWMP submitted to the Ohio EPA in 2005 made use of the established technology of the time that called for deep underground tunnels to store and convey excessive wet weather flow or Rainfall Derived Inflow and Infiltration (RDII). When excessive RDII occurs, the amount of water entering the sanitary sewer system can exceed the capacity of the sanitary sewer system resulting in a sanitary sewer overflow or SSO. Over time, sewer pipes have developed cracks and leaky joints that allow the infiltration of storm water into the sanitary sewer, causing it to exceed capacity and overflow into streams and rivers or back-up into basements. Foundation drains that connect directly to the sanitary sewer also contribute to the problem of rain water getting into the sanitary sewer system. Blueprint Columbus employs current technology to address the source of the infiltration by keeping rain water and snow melt runoff out of the sanitary sewers and directing it into storm sewers. The goal is to prevent storm water from entering the sanitary sewer system through lateral lining, roof water redirection, and a voluntary sump pump program. Stormwater will instead be directed to green infrastructure where it can filter through layers of stone, soil, and plants before it slowly releases into the storm sewer system that empties into local rivers and streams.

To date several areas across the city have been identified for the application of the aforementioned best management practices. One of these areas, the Clintonville neighborhood, has been the focus of implementation and stormwater monitoring. Two tributaries to the Olentangy River, Adena Brook and Beechwood Run, were included in the 2020 study area. Blueprint Columbus is documented in more detail in the 2015 Wet Weather Management Plan (WWMP) Update Report (Columbus DOSD 2015). This WWMP update was approved by Ohio EPA on December 1, 2015. Adena Brook was sampled again in 2022 along with eight (8) other Olentangy River tributaries.

Other Major and Significant Point Sources

Three other WWTPs discharge to the Middle Scioto River mainstem, but collectively they represent only 5.6% of the total effluent discharged by all WWTPs. Two, Commercial Point and South Bloomfield, are minor discharges, each with expected increases in population growth. The Circleville WWTP is a major discharge comprising only 6.3% of the $Q_{7,10}$ flow at Columbus.

Commercial Point WWTP (Scioto River RM 115.35)

The Commercial Point WWTP is a Class II facility and a minor discharge with an average design flow of 0.430 MGD located just upstream from St. Rt. 762. It was constructed in 2009 serving the Village of Commercial Point and a population of 1,591 persons. The population is expected to grow substantially related to the growth of Columbus and increased commercial development. The WWTP offers advanced wastewater treatment and there are no significant bypasses and no CSOs.

South Bloomfield WWTP (Scioto River RM 109.29)

The South Bloomfield WWTP is a Class II facility and a minor discharge with an average design flow of 0.500 MGD located just downstream from St. Rt. 316. It was constructed in 2011 serving the Village of South Bloomfield and a population of 2,225 persons. The population is expected to increase relative to the growth of the greater Columbus region and increased commercial development throughout the area. The WWTP offers advanced wastewater treatment and there are no significant bypasses and no CSOs.

Circleville WWTP (Scioto River RM 99.2)

The Circleville WWTP is a major discharge with an average design flow of 4.0 MGD located along U.S. Rt. 22 west of Circleville. The facility was originally constructed in 1977 with the most recent major upgrade occurring in 1993 and another major upgrade currently underway. Construction for improvements to the facility include upgrades to the head works and electrical system. The collection system serves only the City of Circleville (population 13,928) consisting entirely of separate sanitary sewers. There are no engineered or constructed bypasses or overflows in the collection system. The General Electric Lamp Plant is the single industrial contributor with a flow of 0.026 MGD. The City implements an approved pretreatment program. The WWTP offers secondary treatment.

Delaware Co. Olentangy Environment Control Center WWTP (RM 13.50)

The Olentangy ECC WWTP is the only major discharge to the Olentangy River in Franklin Co. and is owned and operated by Delaware Co. The WWTP is an advanced treatment facility with an average design flow of 6.0 million gallons per day (MGD). The facility was originally constructed in 1980 to deal with anticipated population growth in northern Franklin and southern Delaware Counties. The most recent major upgrade occurred in 2009 with another upgrade currently underway. The treatment plant serves the City of Powell, portions of Dublin, and Liberty, Orange, Berlin, and Concord Townships in Delaware County. The facility has one manual bypass that re-routes a portion of flow around the tertiary filters and disinfection chamber. However, bypassing disinfection is prohibited during the May through October recreation season. The

sewer system is 100% separated. There is an approved pretreatment program with two categorical users that discharge 0.011 MGD of flow.

Nonpoint Sources and Subcoregion Characteristics

The Middle Scioto River study area lies almost entirely within the Loamy, High Lime Till Plains subregion (55b) of the Eastern Corn Belt Plains ecoregion (ECBP; Omernik 1987; Woods et al. 1998). The upper Scioto River and Olentangy River drainages upstream from Franklin Co. lies entirely within the Clayey, High Lime Till Plains subregion (55a). The Level IV subregions offer more relevant detail about the four components of ecoregions; surficial geology, soils, potential natural vegetation, and land use (Woods et al. 1998) that affect the make-up and characteristics of nonpoint sources of pollution. The key characteristics of each subregion appears in Table 8.

Table 8. Level IV subregions of the 2022 Scioto and Olentangy River study area and their key attributes (from Woods et al. 1998).

Level IV Subregion	Physiography	Geology	Soils	Potential Natural Vegetation	Land Use/Land Cover
Clayey, High Lime Till Plains (55a)	Glaciated; broad nearly level glacial till plain; also basins and end moraines; low gradient streams.	Clayey, high lime, late-Wisconsinan glacial till, lacustrine deposits, and scattered loess overlie Paleozoic shales, carbonates, and sandstones.	Alfisols (Epiaqualfs, Hapludalfs), Mollisols (Argiaquolls, Endoaquolls)	Mostly beech forest; scattered elm-ash swamp forest in lacustrine basins and poorly-drained areas; wet prairies behind end moraines in northern counties.	Extensive corn, soybean, wheat, livestock, and dairy farming on artificially drained soils; scattered pin oak-swamp, white oak woodland, and beech-maple woodland.
Loamy, High Lime Till Plains (55b)	Glaciated; level to rolling glacial till plain with low gradient streams; also end moraines and glacial outwash landforms.	Loamy, high lime, late-Wisconsinan glacial till and also glacial outwash and scattered loess overlie Paleozoic carbonates and shale.	Alfisols (Hapludalfs, Epiaqualfs, Endoaqualfs), Mollisols (Argiaquolls, Endoaquolls, Argiudolls), Entisols (Fluvaquents)	Mostly beech forest; also, oak-sugar maple forest, elm-ash swamp forest on poorly-drained valley bottoms and ground moraines.	Extensive corn, soybean, and livestock farming; also scattered beech-maple, pin oak-swamp, white oak woodlands. Urban-industrial activity in municipal areas.

Nonpoint sources within and upstream of the 2022 study area are typical of land form, soils, and land uses within the Clayey, High Lime Till Plains (55a) and Loamy, High-Lime Till Plains

subregions (55b) of the Eastern Corn Belt Plains ecoregion. These subregions are differentiated from the surrounding subregions by having loamy, high lime, late-Wisconsinan glacial till and also glacial outwash and scattered loess that overlies Paleozoic carbonates and shale. Both subregions are glaciated with level to rolling glacial till plains with end moraines and glacial outwash landforms. Originally, beech and oak-sugar maple forests predominated in the uplands with elm-ash swamp forests in poorly-drained valley bottoms and ground moraines, and mixed oak forests on the Pickaway Plains south and west of Franklin Co. Predominant land uses include agricultural row cropping mostly upstream from the 2022 study area and south of Columbus along the mainstem and tributaries. According to a 2015 study, nutrient delivery to the two City of Columbus water supply reservoirs located on the Scioto River just upstream from the 2022 study area has increased in terms of total phosphorus during 1987-2013 (Brown and Caldwell 2015). This is a reflection of nutrient delivery primarily from agricultural land uses that are predominated by row cropping. These loadings can be delivered downstream into the study area particularly during periods of elevated flows when the retention time through the O'Shaughnessy and Griggs Reservoirs is as few as two days (mean = 12 days). This contrasts with the much longer retention times (mean = 180 days) of the other two water supply reservoirs located on Alum Creek and Big Walnut Creek (Alum Creek and Hoover Reservoirs), thus blunting the downstream delivery of nutrients and sediment.

Urban and suburban land uses are concentrated in Columbus and its suburbs. The intensity of urban development is highest inside the city limits with the subcategory of suburban land use consisting of lower density residential development in the suburbs which are rapidly expanding all around Columbus. The increase in impervious surfaces (i.e., parking lots, highways, driveways, rooftops, etc.) in both the suburban and metropolitan areas has altered the hydrology by fostering flashy flows and increasing the delivery of pollutants to tributaries and the mainstem rivers. An increased frequency of high flows can increase streambank erosion particularly those denuded of woody riparian vegetation by encroaching land uses, thus degrading habitat and contributing excess sediment to receiving streams and rivers.

Physical and Hydrological Alterations

Habitat Modifications

The Scioto River, through and just downstream from downtown Columbus, was widened and dammed in response to a record flood that decimated parts of the city in 1913. The remnants of the original channelization are still evident in an over-widened channel in a 5.2 mile long reach between the Olentangy River confluence and the Jackson Pike wastewater treatment plant (WWTP). Remnants of this modification of riverine habitat are also evident in the reach between Greenlawn Dam to just downstream from Frank Rd. Adding to that modification are the legacy effects of instream gravel mining that removed most of the islands and which deepened an already over widened river channel.

The most significant remaining modifications to riverine habitat are in the form of impoundments formed by several dams, most of which are impassable to fish moving upstream. The removal of the 93-year old Main Street Dam in downtown Columbus was

completed in 2014. This dam impounded 2.3 miles of the Scioto River, artificially enlarging the channel width to an average of 150 m (492 ft.). Riffles and pools were restored in an effort to provide better habitat for native plant, fish, and mussel species (Stantec 2012) and natural recovery will likely take several years or decades. The Fifth Avenue Dam was removed in the lower Olentangy River in 2014 two miles upstream from the confluence with the Scioto River in downtown Columbus. The remaining impoundments and barriers to upstream fish movement in the study area are the Dublin Road Water Treatment Plant Dam and Greenlawn Dam on the Scioto River and the Dodridge Street and Union Cemetery Dams on the Olentangy River (Figure 1). Three smaller low head dams also occur in the Olentangy River upstream from the Union Cemetery Dam. The Greenlawn Dam is the downstream-most barrier to upstream fish movement which isolates the mainstem upstream to the Dublin Rd. Water Treatment Plant (WTP) dam and the Olentangy River downstream from the Dodridge Street Dam. It also forms the longest remaining impoundment in the Scioto River. The 129.8 miles of the mainstem downstream from the Greenlawn Dam are open downstream to the Ohio River at Portsmouth, OH.

RESULTS AND DISCUSSION – SCIOTO RIVER MAINSTEM

Chemical/physical water quality in the 2022 Scioto and Olentangy River study area was characterized by grab sample data collected from the water column six times at each site during base flows and within a June 16-October 15 seasonal index period. Continuous measurements were made with Datasondes over 3-4 consecutive day periods at selected mainstem sites in late July and early August and over 3 months (July 1-September 30) at three (3) of the same locations and one USGS operated location. Sediment chemistry was determined from samples collected at all mainstem and selected tributaries in mid-October.

The results were evaluated by assessing exceedances of criteria in the Ohio WQS, by exceedances of regionally derived biological effect and reference thresholds (Ohio EPA 1999a, 2020; Miltner 2018, 2021) for parameters that lack formal criteria in the WQS, and by exceedances of probable and severe and threshold and lowest effect levels for sediment chemistry (Persuad et al. 1993; MacDonald et al. 2000). The chemical/physical results primarily served as indicators of exposure and stress and in support of the biological data for assessing the attainment of aquatic life uses and for assigning associated causes and sources for impairments. Fecal bacteria data were collected by grab samples at all sites and were used primarily to determine the status of recreational uses in accordance with the Ohio WQS. Ohio EPA protocols for determining attainment of the applicable designated recreational use were followed.

Flow Regime

The flow regime in the 2022 Middle Scioto River mainstem the period May 1 – October 31 during 2010, 2015, 2020, and 2022 and annually during 1990-2023 is depicted in Figure 6 based on data recorded by the gauge operated by the U.S. Geological Survey at Frank Rd. in Columbus (USGS 03227500). The four years of daily flows represent the most recent Ohio EPA, the 2015 MBI, and 2020 and 2022 DOSD surveys each with a different periodicity of both high and low flows. The flow regime in the Middle Scioto River mainstem is heavily influenced by two factors; 1) flow releases by the Delaware Dam approximately 26 miles upstream, and 2) withdrawals of water by the Dublin Rd. WTP which can seasonally remove nearly all of the flow in the Scioto River at the WTP intake leaving little or no flow in the Scioto River mainstem to the Olentangy River confluence, a distance of more than one mile. The Delaware Dam can provide for sustained elevated flows, especially if runoff in the upper watershed in Delaware, Marion, and Wyandot Counties is elevated, in order to maintain the summer recreational pool in the Delaware Reservoir. In contrast, the Dublin WTP can exacerbate low flow periods as the demand for drinking water is independent of available downstream flows. While the potential effects of sustained low flows in the Scioto River below Columbus are obvious, the intermittent spates of elevated flows resulting from releases by the Delaware Dam have the potential beneficial effect of “relieving” periodic episodes of low flow pollutant stresses. The summer-fall flow regime in 2022 was below “average” with extended periods of flows below the 50th percentile, but at least five spates above the 90th percentile flow. For reference the 50th percentile flow at the USGS Columbus gage located just downstream from Frank Rd. of 531 cfs (cubic feet per second) is 10 times the Q_{7,10} flow of 53.1 cfs and more than four (4) times the

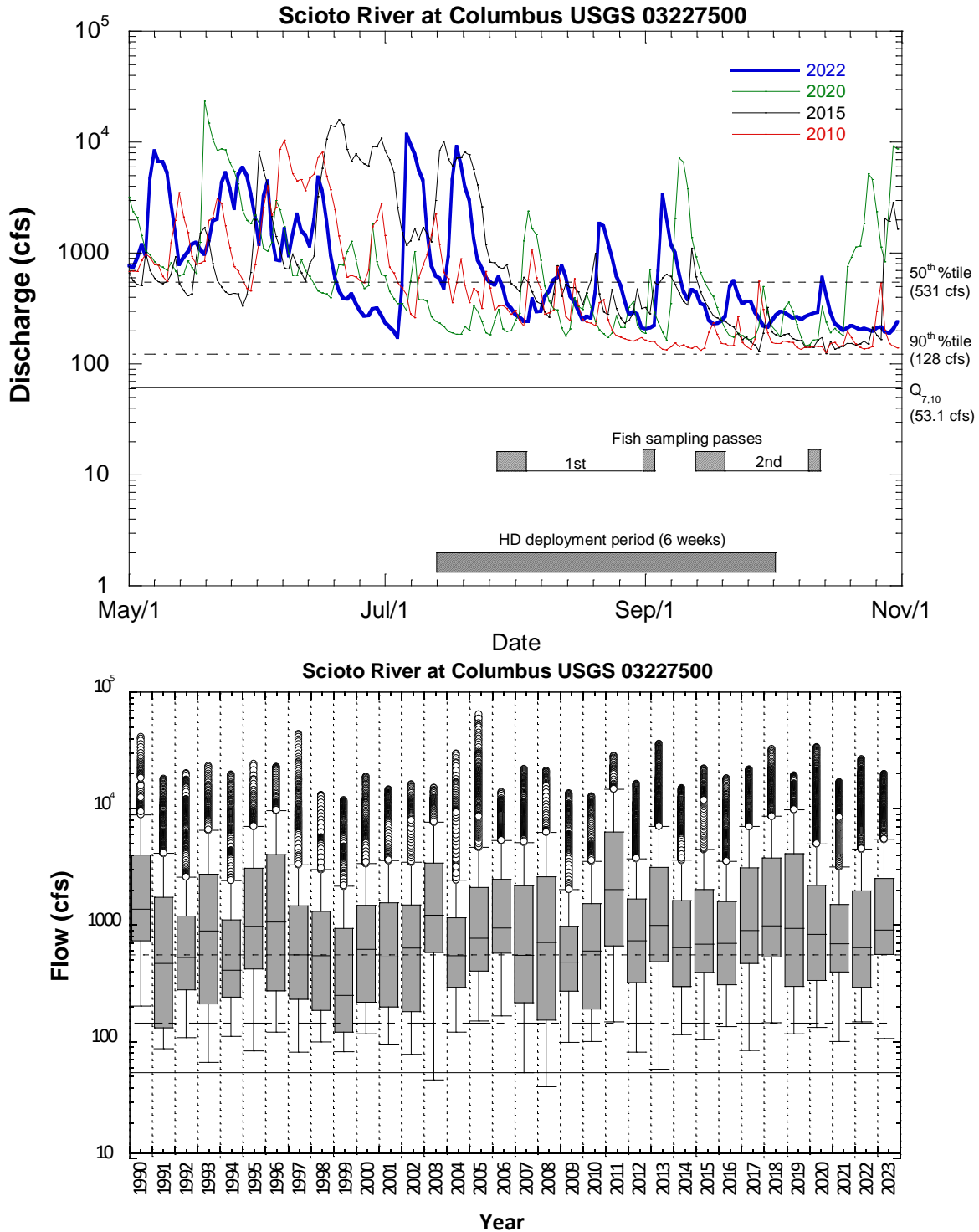


Figure 6. Daily (upper) and annual (lower) flow measured at the USGS gage on the Scioto River (USGS 03227500) near Frank Rd. in Columbus during May 1-October 31 in 2010, 2015, 2020, and 2022 and as a boxplot for a 34 year period 1990-2023. The horizontal lines are the 50th percentile (median), the 90th percentile, and the seven-day, ten year (Q_{7,10}) critical low flows as determined by USGS (Johnson and Metzker 1981). The span of biological data collection in 2020 is indicated by shaded bars.

90th percentile flow of 128 cfs. Wasteload allocations (WLA) for point sources are based on the Q_{7,10} flow¹⁰ as a “worst case” condition. Compared to the most recent survey years of 2010, 2015, 2020 and 2022, minimum flows were the lowest in 2010 and mostly the same or slightly higher in 2015, but no year had flows below the 90th percentile of 158 cfs. The most recent year of extensive below critical low flows occurred in 1988.

The variability in the May-November annual flows was assessed by using box-and-whisker plots to determine year to year and long term trends, if any, in summer-fall river flows. As expected, all of the outliers that are two interquartile ranges above the median are due to spates of high flows that occurred in every year. The median annual flow exceeded the 50th percentile flow in 24 of the 34 years included in Figure 6. By comparison, only four years had median flows less than the 50th percentile of 531 cfs. Only two years, 2003 and 2008, had minimum flows less than the Q_{7,10} flow of 53.1 cfs while all except four years had minimum flows less than the 90th percentile flow. No pattern of increase over the 34 year period was evident due to the variability between years.

Major Point Source Pollutant Loadings

Historical Trends in Aggregate Point Source Loadings

Historical trends in aggregate point source loadings from NPDES permitted discharges was accessed from the Ohio EPA Liquid Effluent Analysis and Processing System (LEAPS) for the years 1976-1994 and the Ohio EPA Surface Water Information Management system (SWIMS) for 1995-2022. The LEAPS data was further formatted and analyzed by MBI where it is stored in a cloud based system and for statewide data about major NPDES discharges. Third quarter (July 1-September 30) data was extracted from the LEAPS and SWIMS systems and formatted in a Fox Pro database format. Aggregate loadings in multiyear increments of time beginning with the period 1976-81 and through the most recent period of 2016-22 are depicted in Table 8. The 1988-89 period was preserved since that coincided with the reduction in loadings at major WWTPs in response to the U.S. EPA National Municipal Policy that was described earlier.

Over the entire 47 year period of record for NPDES compliance reporting during 1976-2022, effluent flows increased by 30% (21% in 2016-20), but loadings of all in common parameters except for nitrate-N declined. Loadings of ammonia-N declined by 95.0% (95.2% in 2016-20) followed by CBOD₅ with a 75.3% decline (77.2% in 2016-20), TSS with a 70.1% decline (71.0% in 2016-20), and total phosphorus with a 37.4% decline (32.8% in 2016-20). Nitrate-N loadings increased by 70.5% compared to 56.8% in 2016-20 the increases of which are largely due to the nitrification of ammonia-N. Major point sources were initially five (5) increasing to six (6) by 2010. Two sources, Techneglass in Columbus and Jefferson Smurfitt (formerly CCA) in Circleville, ceased discharging in the mid-1990s. Two new and smaller WWTPs, Commercial Point and South Bloomfield, initiated operations in the mid- to late 2000s with both currently expanding to service increased development in each community. Overall, these results demonstrate the effectiveness of water quality based permitting for the major WWTP

¹⁰ Some WLAs (e.g., ammonia-N) are based on the Q_{30,10} flow.

Table 9. Summary of aggregate effluent loadings discharged by major point sources across the span of NPDES permit compliance reporting in increments of 5 years (except 1988-89 and 2016-22). The net change between 1976-81 and 2016-22 is expressed as % at the bottom of the table (red are %reductions in loadings). The yellow highlighted total P loadings are likely underestimates due to a lack of reporting by most sources during 1996-2005.

Year Range	Flow (MGD)	CBOD ₅ (kg/day)	TSS (kg/day)	NH ³ -N (kg/day)	NO ³ -N (kg/day)	P (kg/day)	Sources (N)
1976-81	131.4	6900.4	7274.0	2766.0	3415.1	1976.6	5
1982-87	134.7	4151.5	4672.1	1845.4	4062.0	1887.3	5
1988-89	157.7	1589.7	4325.3	134.3	5449.9	1527.4	5
1990-95	152.3	1595.1	3906.0	136.2	5059.1	1035.0	5
1996-00	152.0	1650.9	2660.8	103.2	5756.1	17.6	5
2001-05	164.6	1576.8	2189.7	97.1	5685.7	708.2	5
2006-10	148.8	1656.3	1993.5	136.0	5633.1	959.7	6
2011-15	157.5	1427.0	2396.1	114.8	5433.8	1369.3	6
2016-22	170.8	1707.4	2176.4	137.7	5823.3	1237.3	6
%Change	30.0%	-75.3%	-70.1%	-95.0%	70.5%	-37.4%	6

parameters - ammonia-N, CBOD₅, and TSS. The data for total phosphorus may be somewhat less reliable with most entities not reporting effluent concentrations between 1996 and 2005. Loadings of total P and nitrate-N during 2016-22 from all point sources accounted for in Table 9 are a fraction of the total loadings documented by Ohio EPA (2020) in their ongoing mass balance study of major river basins in Ohio. Third quarter WWTP total P comprised less than 20% and nitrate-N 7.2% of the total annual loadings from all sources.

Historical trends prior to 1976 were more difficult to access since that data is not included in LEAPS or any other electronic data storage system that is readily available. A prior analysis by Yoder et al. (1981) produced a pre-1976 analysis WWTP loadings discharged at effluent location 001 compared to bypassed loadings. That analysis puts the 1976-2022 data into better perspective by demonstrating the reductions of bypassed loadings achieved before 1976 via secondary treatment and the improved system capacity provided by the Southerly WWTP in 1967-68. D.O. concentrations at a now inoperative continuous monitoring location at Shadeville (RM 119.9), which is 7.1 miles downstream from Jackson Pike, improved in terms of a stark reduction in exceedances of the WWH 4.0 mg/L minimum criterion over that same time frame (MBI 2022). The decline in discharged loadings is even more remarkable when compared to the totals discharged in the 1960s and 1970s when bypassing was more frequent and when it comprised a significant fraction of the total loadings discharged to the mainstem. The highest loadings that included both final effluent and bypasses from both Jackson Pike and Southerly at 26,831 kg/day was nearly four times that discharged during the 1976-1981 period as shown in Table 9. Even with some inconsistent reporting of bypasses during that time, this data makes the loading reductions achieved by advanced wastewater treatment in the early 1990s and sustained through 2022 all that more impressive.

Loadings Trends at Individual WWTPs 1976-2022

The discharge of pollutants by point sources to the Middle Scioto and Lower Olentangy River mainstems is currently dominated by the two City of Columbus WWTPs, Jackson Pike and Southerly. The Olentangy ECC located in the upper portion of the Lower Olentangy River mainstem and the Circleville WWTP located at the lower end of the Scioto River mainstem are the only other major municipal discharges. These and two minor municipal discharges located downstream from Southerly contributed a much smaller fraction of the overall point source loadings during the 2016-22 time frame (Table 7; Figure 7). The Southerly WWTP discharged the highest effluent flow and loadings of CBOD₅, NH₃-N, and NO₃-N while Jackson Pike discharged the highest loadings of TSS and total phosphorus. Together Jackson Pike and Southerly discharged 97.5-98.7% of the flow and loadings by the permitted point sources in the 2022 study area.

Trends in effluent loadings at the major WWTPs was accessed from the Ohio EPA Liquid Effluent Analysis and Processing System (LEAPS) for the years 1976-1994 and the Ohio EPA Surface Water Information Management system (SWIMS) for 1995-2022. The LEAPS data was further formatted and analyzed by MBI where it is stored in a cloud based system and for statewide data about major NPDES discharges. Third quarter (July 1-September 30) data was extracted from the LEAPS and SWIMS systems and formatted in a Fox Pro database format. Frequency plots for consistently reported parameters such as effluent flow (MGD) and loadings of CBOD₅ (Kg/day; BOD₅ prior to 1990), ammonia-N (NH₃-N), total suspended solids (TSS), nitrate-N (NO₃-N), and total phosphorus were developed to demonstrate trends through time in the 2020 report (MBI 2022). Proportional loadings were calculated for each WWTP for the 2016-22 period in this report.

Jackson Pike WWTP Effluent Loadings Trends (1976-2022)

The loadings analysis demonstrate the effect of improved wastewater treatment at Jackson Pike in reducing loadings of CBOD₅-BOD₅, TSS, and ammonia-N and in accordance with water quality based NPDES permit limits that were achieved via Project 1988. Median third quarter flows were at or above the average design flow of 68 MGD on a frequent basis throughout the 45 year time period. Peak flows remained well below the 150 MGD wet weather capacity, but have approached or equaled that value more frequently since 2015. Loadings of nitrate-N and phosphorus also showed reductions over the 45 year time frame although these parameters are not directly treated by the advanced wastewater treatment process.

Historical trends prior to 1976 were more difficult to access since that data is not included in LEAPS or any other electronic data storage system that is readily available. A prior analysis by Yoder et al. (1981) produced a 1966-1979 analysis of BOD₅ loadings discharged at effluent location 001 compared to bypassed loadings. This analysis puts the 1976-2022 data into better perspective by demonstrating the reductions of bypassed loadings achieved before 1976 via secondary treatment and the improved system capacity provided by the Southerly WWTP in 1967-68. D.O. concentrations at a now inoperative continuous monitoring location at Shadeville (RM 119.9), which is 7.1 miles downstream from Jackson Pike, improved in terms of a reduction in exceedances of the WWH 4.0 mg/L minimum criterion (MBI 2022).



Wastewater Treatment Plant	Flow (MGD)	CBOD ₅ (kg/day)	TSS (kg/day)	NH ₃ -N (kg/day)	NO ₃ -N (kg/day)	Total P (kg/day)
Jackson Pike	69.3	605.3	1186.0	33.5	1941.7	701.2
Columbus Southerly	95.8	1040.4	944.5	94.4	3736.6	507.1
South Bloomfield	0.2	1.4	2.7	0.3	20.4	2.1
Commercial Point	0.3	4.0	8.0	0.1	33.6	4.9
Circleville	1.8	36.5	20.3	5.6	43.6	18.8
Total Loadings	167.3	1687.6	2161.5	133.9	5775.9	1234.2

Figure 7. Proportions of effluent flow (MGD) and pollutant loadings (Kg/day) discharged by six WWTPs to the Middle Scioto and Lower Olentangy study area 2016-22. Proportions and loadings are based on third quarter (July 1-Sept. 30) averages of each parameter. Discharges are listed in order from upstream to downstream in the inset table at the bottom.

Southerly WWTP Effluent Loadings Trends (1976-2022)

The 2022 loadings analysis results demonstrate the effect of improved wastewater treatment at Southerly in dramatically reducing loadings of CBOD₅-BOD₅, TSS, and ammonia-N and in accordance with water quality based NPDES permit limits that were achieved via Project 1988 (MBI 2022). Median third quarter flows were mostly below the average design flow of 114 MGD throughout that 45 year time period. However, median flows increased by 50-100% with the completion of Project 88. Peak flows have increased steadily since 2003 reaching the wet weather flow capacity of 330 MGD in 2018. Median loadings of nitrate-N showed a 2-3 fold increase after Project 88 presumably a byproduct of improved nitrification for ammonia-N removal. Values after 1988 showed a slight, but erratic increase through the latter portion of the 2010-22 period. Total phosphorus showed reductions initially after 1976-79 and then maintained consistent loadings of 500 kg/day through 2022.

The prior historical analysis by Yoder et al. (1981) also produced an analysis of 1966-1979 BOD₅ loadings discharged at the Southerly 001 effluent and 002 plant bypass. The results showed the comparatively lesser loading discharged during the initial start-up year of 1967, but increasing thereafter. As Southerly took on more of the share of total sewage inflows from Jackson Pike, the effluent loadings increased substantially. Bypassed loadings first appeared in 1971 and increased steadily through 1979 (Yoder et al. 1981). By 1978 the bypassed loadings surpassed the treated loadings most of which was discharged at outfall 002 about 0.5 miles upstream from outfall 001. The bypassing of raw sewage was largely resolved beginning with the composting of sludge in the early 1980s and then by Project 88 with all dry weather raw sewage bypassing eliminated by 1992 (MBI 2022).

Circleville WWTP Effluent Loadings Trends (1976-2022)

The Circleville WWTP is located in the lower most portion of the Middle Scioto River and discharges only a fraction of the wastewater discharged by the two (and much larger) Columbus facilities. Of the total effluent flow and loadings of CBOD₅, ammonia-N, TSS, nitrate-N, and total P discharged by all of the major WWTPs, the Circleville effluent comprised only 0.9-4.2% of that total. Median flows throughout the 1976-2022 period were less than one-half the average design flow of 4.0 MGD averaging 1.77 MGD during 2016-22. CBOD₅ loadings declined dramatically in 1978 just two years after the facility was upgraded to secondary treatment and have remained at this level throughout the entire time period. TSS loadings closely paralleled CBOD₅ and both were well within permitted limits. Loadings of ammonia-N were generally in the 30-60 Kg/day range until 2001 after which loadings declined to less than 10 Kg/day where they have remained with the exception of two years, 2016 and 2017 (MBI 2022). There are no permit limits for ammonia-N as secondary treatment is sufficient to meet the water quality criterion. Nitrate-N showed an overall decline, but with a sharp decline in 1985 followed by a perceptible, but small increase. Total P declined from a high median value near 75 Kg/day after which most values declined to less than 30-40 Kg/day. Gaps in the total P data exist for a period of 17 years 1991-2008. The plant is currently undergoing a major upgrade.

Minor WWTP Discharges

The Commercial Point and South Bloomfield WWTPs are two of newer discharges to the middle Scioto River and classified as minor discharges with design flows of 0.43 and 0.50 MGD, respectively. Average 2016-22 third quarter flows have been well below that level at 0.28 and 0.17 MGD, respectively. Together these two WWTPs comprised 0.2-0.9% of the total WWTP loadings in 2016-22. The areas served by these facilities are undergoing the first stages of rapid development that is expected to keep pace through 2050 with the rest of the central Ohio region. The Commercial Point WWTP is presently undergoing a major expansion.

Scioto River Mainstem Water Column Chemistry

Water quality was assessed by grab samples collected at all sampling locations six times during the summer-fall index period. Parameter groupings included field, demand, ionic strength, nutrients, heavy metals, and organic compounds. For many of the more commonly monitored parameters sufficient data was available to examine the longitudinal or “pollutional profile” of the mainstem comparing the 2020 and 2022 results. The 2020 report documented changes in increments of time dating back to 1980 including long term trends for the reach of the mainstem that is impacted by the major sources of treated wastewater that in some cases include data from the late 1960s and 1970s (MBI 2022).

Four parameters were monitored continuously over consecutive day periods ranging from four (4) days up to two weeks using YSI Datasonde continuous recorders. Longer term deployments were made at three of these locations during July 1-September 30 plus a USGS location at Shadeville offered the same type of data. Dissolved oxygen (D.O.), temperature (°C), pH (S.U.), and conductivity ($\mu\text{S}/\text{cm}$) were included. The short-term deployments were made during low flows and maximum temperatures as much as was possible. In 2022 deployments of multiple Datasonde units consisted of river mainstem segment surveys during August 10-14, August 15-18, August 16-19, August 25-29, August 31-September 13, and September 14-27, 2022. The short-term Datasonde deployments were conducted under as close to “worst case” conditions for that year, providing information that cannot be gained from grab sample data alone. It makes an evaluation of compliance with the Ohio WQS for parameters with average and maximum criteria more realistic. Sediment chemistry was collected once at each of 25 ambient mainstem sites and Big Walnut Creek.

The 2022 report is focused primarily on any differences between 2020 and 2022. Historical analyses that date back to the 1960s and 1970s were presented and assessed in the 2020 Scioto and Olentangy retrospective (MBI 2022). Most of the 2022 grab sample results are presented in tabular format although a few of the more commonly measured parameters are depicted graphically in longitudinal plots along the mainstem. The goal herein is to compare the 2022 results with 2020 for any changes between those two years.

Conventional, Demand, and Nutrient Parameters

Conventional parameters include the most commonly collected parameters in water quality

surveys such as temperature and pH. Total suspended solids (TSS) and conductivity are sometimes included in this group, but for the purposes of this analysis both are considered urban parameters. Demand and nutrient related parameters consist of those related to the discharges of treated and untreated sewage, organic enrichment from point and nonpoint sources, nutrient parameters and their effects, and physical parameters such as total suspended solids each being collected six (6) times during the summer-fall seasonal index period. Benthic chlorophyll a samples were collected once from each site during the Datasonde deployments as part of a combined nutrients effect assessment.

Temperature (°C)

Temperature is a critical factor in aquatic systems as it both directly and indirectly influences individual organism health and well-being and various physicochemical processes that also have direct and indirect effects. Fish will avoid lethal temperatures and will seek the temperature regime that each species prefers. Temperature affects chemical rates and processes and the toxicity of certain pollutants (e.g., ammonia-N). While much of the concern with temperature has centered on discharges of heat, modifications and alterations to natural temperature regimes have received increased attention due to climate change.

Temperature was measured at all locations with the collection of each chemical grab sample and during each fish sampling event over the seasonal June-October index period. It was also measured continuously during the short-term deployment of the Datasondes at 23 locations in the middle Scioto River mainstem and Big Walnut Creek. With the shutdown of the Picway electric generating station in May 2015 there are no artificial sources of heat discharge to the middle Scioto River mainstem. However, modifications to flow and habitat can affect or otherwise modify the temperature regime. The temperature criteria in the Ohio WQS consist of monthly average and maximum temperature based on the protection of representative species. The reach downstream from Greenlawn Dam has specific temperature criteria (OAC 3745-1-31) that apply to the Scioto River mainstem from the dam downstream to the Ohio River (Table 35-11[C]). The summer (June 16-September 15) average criterion is 28.3°C (83.0°F) and the maximum is 30.6°C (87.0°F). Upstream from the Greenlawn Dam the mainstem falls under the General Ohio River Basin criteria (Table 35-11[A]) with an average criterion of 27.8°C (82.0°F) and maximum of 29.4°C (85.0°F).

2022 Temperature Results – Datasondes

Temperature was monitored continuously over short periods of time (4-13 days) during low flow and high ambient temperature periods in August and early September 2022 via the deployment of Datasondes at 23 locations in the middle Scioto River mainstem and Big Walnut Creek (Figure 8). The results were judged against the average and maximum temperature criteria in the Ohio WQS that apply during June 16-September 15. Median temperatures ranged from a high of 25.5°C at SR11 (RM 120.1) downstream from I-270S to a low of 21.5°C at SR13 (RM 117.3) downstream from Big Walnut Creek. None of the maximums or outliers surpassed even the season average criteria. The longitudinal trend was a general decline downstream in 2022, the same as observed in 2020.

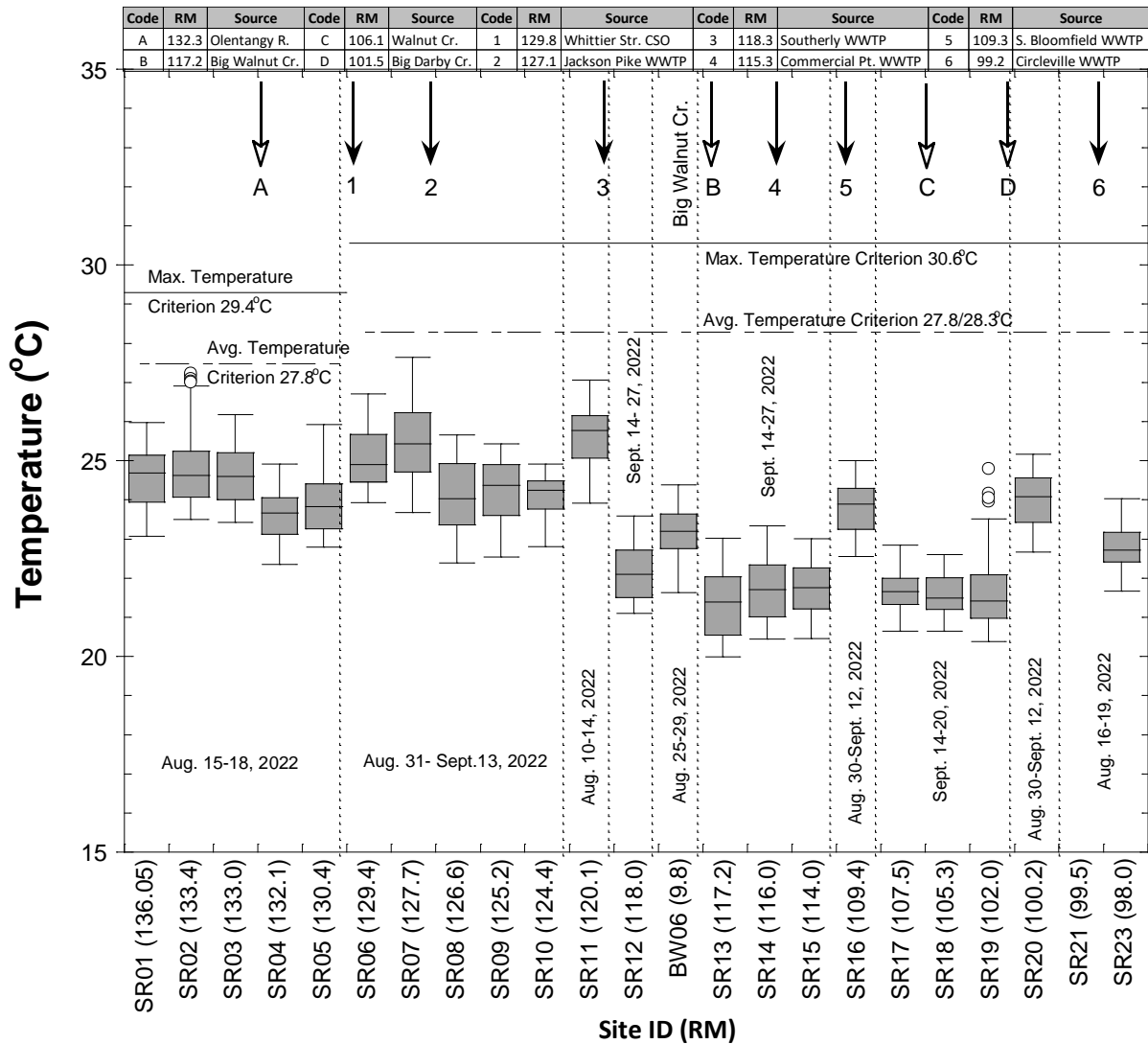


Figure 8. Temperature (°C) measured continuously by Datasondes deployed for discrete periods during August and September 2022 at 23 locations in the middle Scioto River mainstem. Box-and-whisker plots show the minimum, maximum, 25th and 75th percentiles, median, and outlier (>2 interquartile ranges from the median) values. The applicable Ohio EPA average and maximum temperature criteria are shown by solid and dashed lines. Major tributaries (letters) and discharges (numbers) are indicated along the top of the graphic.

In 2022 median temperatures were higher and ranged from a high of 28.5°C at RM 133.4 (SR02) immediately downstream from the Dublin Rd. WTP dam and intake to a low of 24.0°C at RM 100.2 (SR20) at Circleville. Maximum temperatures ranged from 31.8°C at RM 133.0 (SR03) upstream from the Olentangy River confluence and 31.8°C downstream from Greenlawn Dam (RM 1294, SR06) to 25.7°C at RM 114.0 (SR15) downstream from St. Rt. 762. The continuous results were generally higher than the grab sample medians and maximums measured throughout the summer period. The overall longitudinal pattern was characterized by the highest temperatures occurring upstream from the Jackson Pike WWTP (RM 127.1) with the median ranging between 27.5°C at RM 129.4 (SR06) downstream from the Greenlawn Dam (RM

through the remainder of the mainstem. Maximum temperatures were consistently elevated above or at the applicable maximum temperature criterion of 29.4°C at all seven sites on the upper mainstem. The median temperatures were at or just above the applicable average criterion of 27.8°C between RM 136.50 (SR01) downstream from Griggs Dam to the Greenlawn Dam impoundment (RM 129.9, SR05). The maximum value at RM 129.4 (SR06) exceeded the applicable maximum of 30.6°C, but the medians were below the average criterion of 29.4°C due to the change (increase) in the temperature criteria that occurs at Greenlawn Dam. Median temperatures declined markedly by 2.0-3.0°C downstream from the Jackson Pike WWTP (RM 127.1) and then by 3.5-4.5°C downstream from Big Walnut Creek (RM 117.2). Maximum temperatures showed a lesser decline downstream from Jackson Pike, but none exceeded the applicable maximum criterion. Measured temperatures in 2022 were clearly higher upstream from the Greenlawn Dam (RM 129.8) and generally higher upstream from the Jackson Pike WWTP (RM 127.1) seems attributable to the modified flow regime that occurs downstream from Griggs Reservoir including comparatively warmer water from the Griggs Reservoir and the restricted flow especially during low flow periods downstream to Jackson Pike WWTP (RM 127.1). Flows withdrawn at the Dublin Rd WTP intake are largely returned to the mainstem at Jackson Pike leaving the mainstem in between affected by low flow periods and whatever flow enters via the Olentangy River (RM 132.3).

pH

pH is a measure of how acidic/basic water is with a measurement range of 0 to 14. It is a measure of the relative amount of free hydrogen (acidic) and hydroxyl (basic) ions in the water. pH is measured on a logarithmic scale where each number represents a 10-fold change in the acidity or basicness of the water. For example, water with a pH of five is ten times more acidic than water having a pH of six. It is an important factor in how chemicals affect aquatic life and other biological processes. It determines the solubility (amount that can be dissolved in the water) and biological availability (amount that can be utilized by aquatic life) of chemical constituents such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals (lead, copper, cadmium, etc.). For example, pH affects the amount of total ammonia-N that is present in the unionized and toxic form and along with temperature is part of the water quality criterion. At a temperature of 25°C, which is typical of summer ambient temperatures in the study area, a change in pH from 8.5 S.U. to 9.0 S.U. changes the equivalent ammonia-N criterion from 3.20 mg/L to 1.10 mg/L, a decrease of almost 66%. It also affects how much and what form of phosphorus is most abundant in the water, and therefore affects how aquatic plants and animals can utilize it. As a result pH is responsive to algal photosynthesis and respiration similar to D.O. with a diel cycle of pH being higher in daytime and lower at night. Along with hardness it affects the degree to which heavy metals are soluble which determines their toxicity. Reference pH values for large rivers in the ECBP ecoregion range between a median value of 7.9 S.U. and a statistical maximum of 8.5 S.U. The Ohio water quality criteria is a range between 6.5-9.0 S.U.

2022 pH Results – Datasondes

pH was monitored continuously over short periods of time (4-13 days) during low flow and high ambient temperature periods in August and early September by the deployment of Datasondes at 23 locations in the middle Scioto River mainstem and Big Walnut Creek (Figure 9). The results were judged against the pH criteria in the Ohio WQS and regional reference values for large rivers in the ECBP ecoregion. All continuous pH values in 2022 were within the Ohio WQS water quality criteria range of 6.5-9.0 S.U. However, both the median and maximum pH values

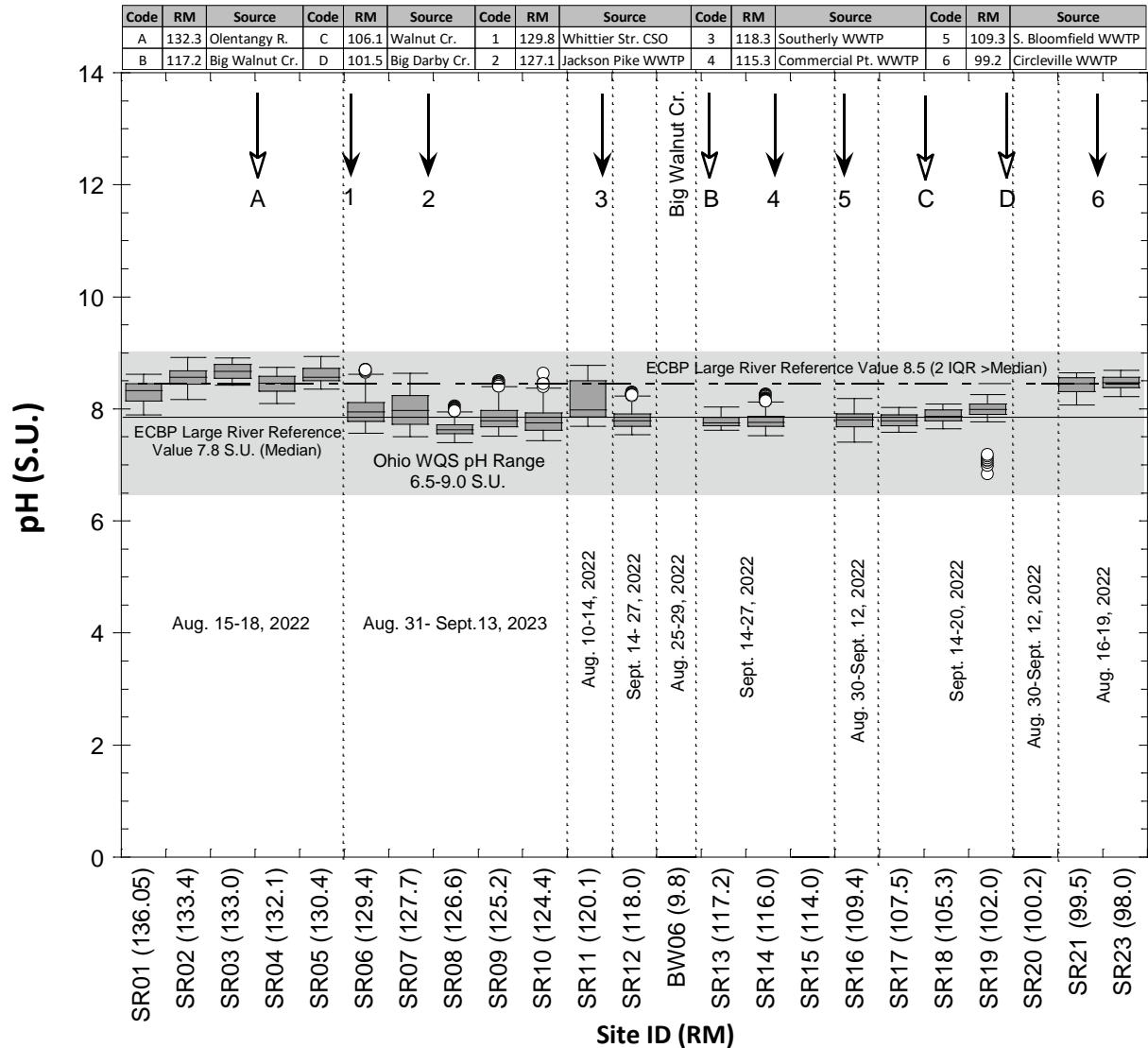


Figure 9. pH (S.U.) measured continuously by Datasondes deployed for 4-14 day periods during August and early September 2022 at 23 locations in the middle Scioto River mainstem and Big Walnut Creek. Box-and-whisker plots show the minimum, maximum, 25th and 75th percentiles, median, and outlier (>2 interquartile ranges from the median) values. The applicable Ohio EPA water quality criteria range is shown by the shaded area and the regional reference values for large rivers in the ECBP ecoregion are shown by solid and dashed lines. Major tributaries (letters) and discharges (numbers) are indicated along the top of the graphic.

showed some variability compared to the regional reference values for large rivers in the ECBP. In the middle Scioto River mainstem pH values varied longitudinally with the highest median and maximum values downstream from Griggs Reservoir (RM 136.50, SR01) and in the extreme lower mainstem where maximum and median pH values exceeded the regional reference thresholds. The trend downstream from the Jackson Pike WWTP (RM 127.1) paralleled that of the expected rate of processing oxygen demanding materials with a “sag” in pH values downstream to RM 124.4 (SR10) and below the regional reference thresholds at sites showing lesser signs of algal activity such as the increases at RM 99.5 (SR 21) and 95.8 (SR23) presumably in response to increased diel algal activity spurred by an increased availability of nutrients. The 2022 results were in line with 2020 (MBI 2022).

Dissolved Oxygen (D.O.)

Dissolved oxygen was characterized in the Scioto and Olentangy Rivers using continuous data collected at 32 locations. All of the locations had short term deployments of 4-14 days and during periods of low flow and high ambient temperature. These were used to support the Ohio EPA Large Rivers Nutrient procedure. Longer term deployments were made at three (3) Scioto River and one (1) Olentangy River location primarily to determine seasonal dynamics and to assess the representativeness of the short term data.

Short Term Continuous D.O. Results

Exceedances of dissolved oxygen (D.O.) were assessed with continuous data obtained from short term Datasonde deployments during August and early September (Figure 10). One of the primary purposes of the continuous D.O. monitoring was to support the combined analysis of the effects of nutrient enrichment following the Ohio EPA approach for large rivers (Miltner 2018). It also provides the data necessary for more fully evaluating the results against the D.O. criteria in the Ohio WQS. In terms of compliance with the Ohio D.O. criteria no sites exceeded either the minimum or average D.O. criteria in 2022. Only one site in 2022, SR01 (RM 136.50) located just downstream from Griggs Reservoir, had exceedances of both the 4.0 mg/L minimum and 5.0 mg/L average for the WWH use designation. The only other sites with a minimum below 4.0 mg/L was SR07 (RM 127.7) located at Frank Rd. upstream from the Jackson Pike WWTP and SR20 (RM 100.2). The width of the diel swing in D.O. values is also provided in Figure 10 by exceedances of the acceptable and maximum values of 12 mg/L and 14 mg/L based on the 7 and 9 mg/L diel swings defined by Miltner (2018). Maximum values were by far the highest in the Greenlawn Dam pool (SR05) in both 2020 and 2022 with a maximum of 24 mg/L in 2022 compared to 19 mg/l in 2020, the two lowermost sites downstream from Circleville (SR21 and 23), and three of the four sites between Griggs Dam and the Olentangy River confluence (SR03), where all sites exceeded the acceptable swing value of 12 mg/L and three (3) exceeded the over-enriched threshold of 14 mg/L. These results are used in the combined assessment of nutrient effects later in this section of the report.

Long Term Continuous D.O. Results

The long term results recorded between mid-July and mid-September at three Scioto River locations over a period of 65-70 days showed the variation in the diel cycle and across the time

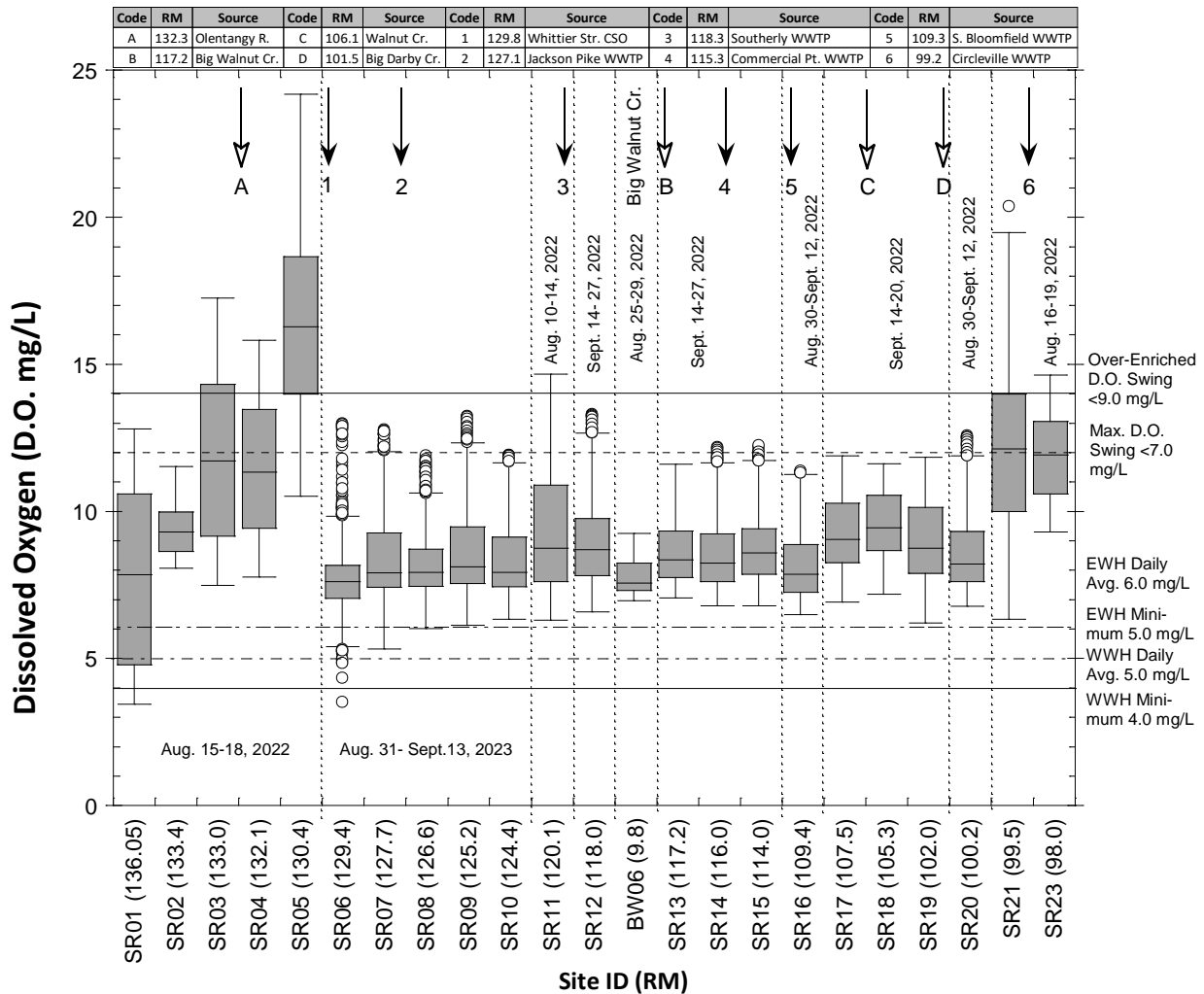


Figure 10. Dissolved oxygen (D.O.) measured continuously by Datasondes deployed for 4-14 day periods during August and early September 2022 at 23 locations in the middle Scioto River mainstem and Big Walnut Creek. Box-and-whisker plots show the minimum, maximum, 25th and 75th percentiles, median, and outlier (>2 interquartile ranges from the median) values. The applicable Ohio EPA water quality criteria are shown by solid and dashed lines. The D.O. values indicative of enriched or over-enriched diel swings are shown by a dashed and solid line. Major tributaries (letters) and discharges (numbers) are indicated along the top of the graphic.

interval during the summer period when lower flows and higher ambient temperatures would be expected to produce the minimum D.O values and also the widest diel swings. Each of the three sites showed that cycle to varying degrees (Figure 11). At the upstream most long term site SR02 (RM 133.4) that is downstream from the Dublin Rd. WTP dam, there were no exceedances of the WWH minimum or average D.O. criteria and only two days where the maximum exceeded the enriched and over enriched values of 12 and 14 mg/L, respectively. The second of three long term site SR11 upstream from St. Rt. 665 at Shadeville. The results are a blend of the MBI long term unit and a Columbus DOW unit operated by USGS. The MBI unit ceased operating at the end of the short term period in August, but it filled a missing data gap

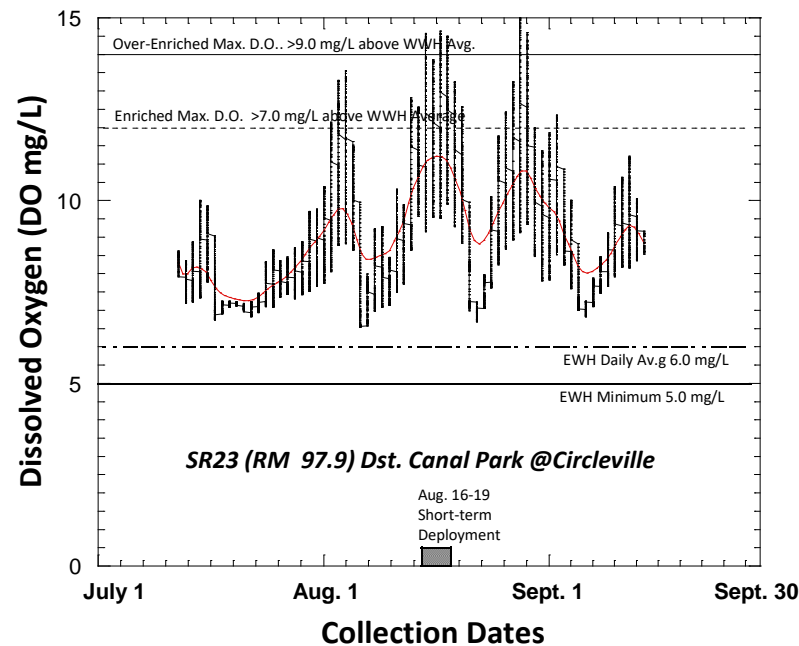
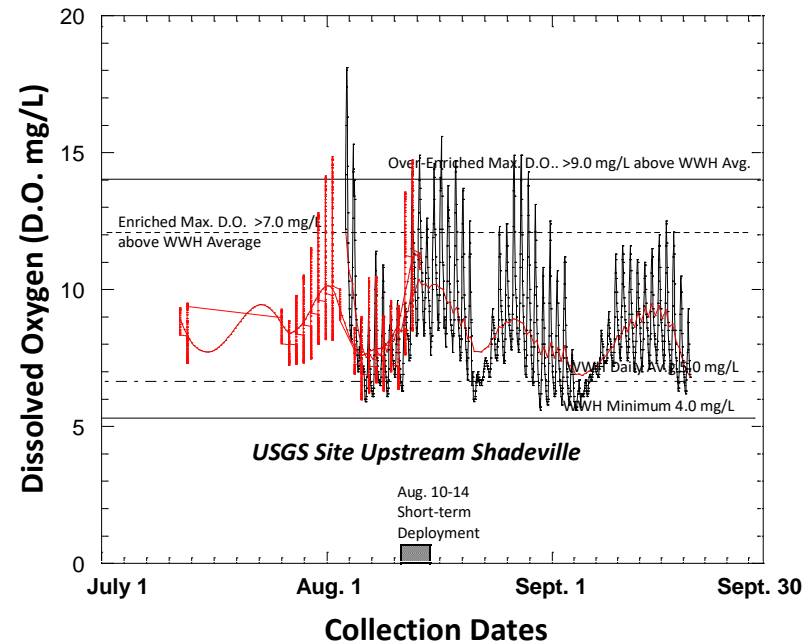
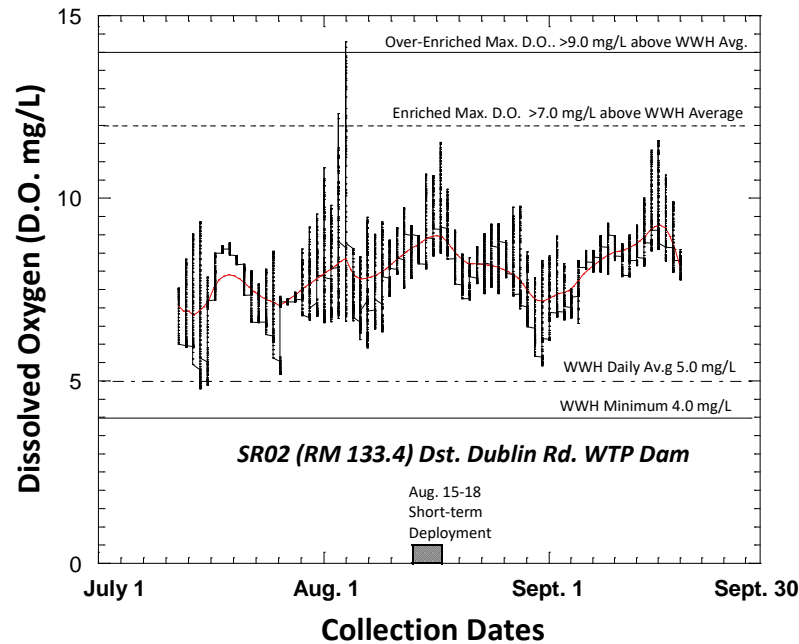


Figure 11. Daily maximum, minimum, and average D.O. recorded at three long term locations in the Scioto River mainstem during mid-July to mid-September 2022. The applicable WWH or EWH daily minimum and average criteria and the values indicative of enriched and over-enriched conditions are shown by dashed and solid lines. The term of the short term deployments are indicated along the collection dates. MBI data was used to supplement missing USGS data at Shadeville (red lines, upper right).

in the USGS data in July. There were no exceedances of the WWH minimum or average D.O. criteria, but frequent exceedances of the enriched and over enriched values of 12 and 14 mg/L, respectively. The highest exceedances occurred outside of the short term period of August 10-14. The third and downstream most long term site at SR23 (RM 97.9) had no exceedances of the EWH minimum or average D.O. criteria and several exceedances of the enriched and over enriched values of 12 and 14 mg/L, respectively. A consecutive day occurrence of these exceedances all occurred during the short term period of August 16-19.

An objective of the long term deployments was to determine how representative are the short term deployments used in the combined nutrients effects assessment against what happens over the comparative long term of the warmest and low flow months of July, August, and September. To accomplish this the number and duration of exceedances of the minimum and average D.O. criteria and the enriched and over enriched values of 12 and 14 mg/L (Table 10). The results generally show that the short term deployments are sufficient to capture exceedances of these thresholds and other D.O. related parameters used in the Ohio EPA Large river nutrient assessment.

The analysis in Table 10 shows some differences in key D.O. thresholds between the sort term and long term results at the same sites. The long term data had lower minimum and mean D.O. values at all three locations and higher maximum D.O. values one of which would have made a threshold exceedance difference. In terms of the duration of exceedances of the 12 mg/L and 14 mg/L maximum D.O. values indicative of enriched and over-enriched conditions the short term data amplified their frequency compared to the long term results at two sites that were the most affected by nutrient loadings. A key question is about the actual effect of short term exceedances vs. the long term results which will inherently include less stressful periods due to the potential “relief” effects of periods without exceedances. A concept similar to the stress/recovery for temperature developed by Bevelhimer and Bennet (2007) would be worth exploring for application to the duration of D.O. exceedances.

Ammonia-Nitrogen (N)

The Ohio water quality criteria are expressed as total ammonia-N with pH and temperature being the key variables used to determine how the total corresponds to the toxic unionized fraction. For the analysis of compliance with the Ohio water quality criteria, a series of combinations of pH and temperature values measured by grab samples and the continuous Datasonde data were derived in the 2020 report (MBI 2022). The analysis of the resulting total ammonia-N criteria values applicable to the Scioto River mainstem were based on three river reach-specific 75th percentile temperature and pH values per the Ohio WQS Implementation Rules (OAC 3745-2). The ammonia-N criterion for the WWH use designation in the three mainstem reaches varied between 0.50-0.60 mg/L as total ammonia-N and was 0.50 mg/L for the EWH reach of the Scioto River downstream from Big Walnut Creek. Based on the U.S. EPA (2013) criteria the resulting total ammonia-N was between 0.32-0.34 mg/L for the three mainstem reaches. The latter represents a roughly 50% reduction in allowable total ammonia-N compared to the Ohio WWH and somewhat less for EWH. The mean ammonia-N in 2022 ranged from 0.014-0.033 mg/L in the Scioto River mainstems in 2022 (Table 11) compared to

Table 10. Summary of short term and long term D.O. results in July, August, and September 2022 at the three long term deployment sites in the Scioto River mainstem. Results include the minimum, mean, and maximum D.O. and the duration of D.O. minimums less than the respective WWH and EWH criteria and the enriched and over enriched values of 12 and 14 mg/L.

Site ID	River Mile	Days	Hours	Earliest Date	Latest Date	Long-term Interval Summary Statistics							
						Min. DO (mg/L)	Mean DO (mg/L)	Max. DO (mg/L)	% Hours <4 mg/L	% Hours <5 mg/L	% Hours <6 mg/L	% Hours Max >12 mg/L	% Hours Max >14 mg/L
SR02	133.40	70	1654	12-Jul-22	19-Sep-22	4.8	8.0	14.3	0.0	0.0	3.6	0.3	0.0
SR11 ^a	120.10	68	1543	12-Jul-22	30-Sep-22	5.6	8.6	15.6	0.0	0.0	0.4	5.9	0.9
SR23	98.01	65	1524	12-Jul-22	14-Sep-22	6.5	9.0	15.1	0.0	0.0	0.0	8.6	1.3
						Short-term Interval Summary Statistics							
						Min. DO (mg/L)	Mean DO (mg/L)	Max. DO (mg/L)	% Hours <4 mg/L	% Hours <5 mg/L	% Hours <6 mg/L	% Hours Max >12 mg/L	% Hours Max >14 mg/L
SR02	133.40	4	95.8	15-Aug-22	18-Aug-22	8.1	9.4	11.5	0.0	0.0	0.0	0.0	0.0
SR11 ^a	120.10	5	98.3	10-Aug-22	14-Aug-22	6.3	9.3	14.7	0.0	0.0	0.0	25.7	9.5
SR23	98.01	4	95.8	16-Aug-22	19-Aug-22	9.3	11.9	14.6	0.0	0.0	0.0	50.2	11.5

^a Combined USGS and MBI Continuous DO Data;

0.020-0.119 in 2020. The longitudinal pattern in median and maximum values was roughly similar, but with consistently lower ones in 2022 (Figure 12). The 2020 median concentrations in the upper mainstem between 5th Avenue (RM 136.5, SR01) and the former Main Street Dam impoundment (RM 132.1, SR04) ranged between 0.030-0.045 mg/L which was among the highest in the study area. The comparative spike in ammonia-N downstream from Griggs Dam was greatly diminished in 2022. With the exception of three mean values at SRJPMZ (RM 127.0), SR09 (125.3), and SR10 (RM 125.8), all other sites had means at the minimum detection limit of 0.014 mg/L. None of the maximum values in 2022 exceeded any of the U.S. EPA (2013) or Ohio WQS thresholds and only the maximum in the Jackson Pike mixing zone (SRJPMZ) exceeded the ECBP large rivers reference threshold. In 2020, the same three sites with elevated mean values had maximums that exceeded the ECBP reference value. Still, all ammonia-N levels measured in both 2020 and 2022 were very low with most at or below the minimum detection levels.

Five-Day Biochemical Oxygen Demand (BOD₅)

Biochemical oxygen demand (BOD) measures the amount of oxygen consumption in mg O₂/L by the aerobic oxidation and consumption of organic matter primarily by bacteria. The higher the BOD the more rapidly D.O. is depleted in the water. The principal sources of BOD in rivers and streams are organic matter including sewage, industrial waste containing organic matter, leaves, soils high in organic matter, woody debris, and dead and decaying algae. Reducing the oxygen demanding properties of municipal wastewater has been an even longer term objective for wastewater treatment than has reductions in ammonia-N. Expressed here as the five-day biochemical oxygen demand (BOD₅), this parameter, too, has reflected the effectiveness of wastewater treatment at the Columbus WWTPs. BOD was originally expressed as total BOD which included both nitrogenous and carbonaceous properties of sewage effluent. As the nitrogenous fraction was addressed by improved nitrification, the measurement changed to carbonaceous or cBOD for measuring treatment effectiveness and reporting compliance. In this analysis the generic BOD₅ expression is used while recognizing that post 1988 values are comprised almost entirely of the carbonaceous fraction. While elevated BOD can reflect excessive inputs by point sources, the widespread control of this parameter by water quality based permitting and subsequent wastewater treatment has greatly reduced it as a major water quality concern. Instead, elevated BOD is now more likely a result of nonpoint source inputs and the indirect effects of flow and habitat alteration that exacerbate the effects of algal dynamics spurred by excessive nutrient enrichment. As a result this is a key parameter in the Ohio large rivers nutrient assessment (Miltner 2018).

2022 BOD₅ Results

Mean and maximum BOD₅ levels in 2022 and 2020 consistently exceeded the 2.50 mg/L “acceptable” level of Miltner (2018) consistently between SR01 (RM 136.5) downstream from Griggs Dam and SR10 (RM 123.8) downstream from I-270S. Exceedances of that threshold occurred although about one-half of the medians were only 0.1-0.2 above that threshold (Table 11). The longitudinal pattern in 2022 was similar to 2020 when most of the minimum values were at or below the MDL of 1.3-1.7 mg/L. Some of the maximum values were within the

Table 11. Mean values for demand and nutrient related parameters in the middle Scioto River mainstem in 2020 and 2022. Bold italic values are the highest between the two years. Values are color coded in accordance with the legend at the bottom.

Site ID	River Mile	Drainage Area (mi. ²)	Ammonia- Nitrogen as Ammonia mg/L (Mean)		BOD 5 Day mg/L (Mean)		Kjeldahl- Nitrogen, Total as N mg/L (Mean)		Nitrate mg/L (Mean)		Nitrite mg/L		Phosphorus Total as P mg/L		Phosphorus, Dissolved Orthophosphate mg/L		TSS (Total Suspended Solids) mg/L	
			2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022
<i>Scioto River</i>																		
SR01	136.5	1050	0.058	0.031	2.68	3.37	0.94	1.16	1.44	2.29	0.04	0.04	0.136	0.243	0.106	0.061	8	12
SR02	133.4	1050	0.039	0.014	2.44	2.88	0.82	1.00	1.36	2.21	0.03	0.03	0.128	0.240	0.114	0.061	9	12
SR03	132.7	1070	0.028	0.014	2.70	3.05	0.84	0.99	1.30	2.13	0.03	0.02	0.155	0.240	0.170	0.061	11	12
SR04	132.1	1610	0.046	0.014	3.08	2.55	0.80	0.84	1.11	1.53	0.03	0.02	0.102	0.240	0.079	0.064	14	12
SR05	129.9	1620	0.023	0.014	4.28	3.62	0.97	0.95	1.12	1.44	0.03	0.02	0.144	0.240	0.086	0.061	48	12
SR06	129.5	1620	0.021	0.014	3.68	3.32	0.85	0.95	1.08	1.57	0.03	0.02	0.085	0.242	0.081	0.061	17	16
SR07	127.7	1620	0.030	0.014	3.70	4.12	0.90	1.02	0.97	0.98	0.03	0.02	0.096	0.240	0.061	0.061	12	14
SR08.2	127.4	1620	0.040	0.014	3.70	4.07	0.80	0.93	0.97	0.84	0.03	0.01	0.110		0.058	0.061	12	
SRJPMZ	127.0	1620	0.119	0.074	4.80	5.18	1.13	1.38	5.25	7.58	0.03	0.02	1.895	2.600	1.818	2.600	5	12
SR08	126.2	1630	0.040	0.037	3.72	4.67	1.03	1.40	2.60	2.33	0.03	0.02	0.782	0.661	0.484	0.940	16	16
SR09	125.3	1640	0.073	0.037	3.50	4.30	0.94	1.42	2.70	4.05	0.03	0.02	0.702	1.117	0.610	0.930	15	14
SR10	123.8	1670	0.055	0.030	3.50	4.08	0.90	1.27	2.43	3.37	0.03	0.02	0.577	0.913	0.545	0.720	13	19
SR11	120.1	1700	0.025	0.014	2.48	3.24	0.77	1.18	2.45	2.67	0.03	0.01	0.773	0.863	0.718	0.765	13	15
SRCSMZ	118.2	1710	0.107	0.014	2.72	3.14	0.54	1.12	11.30	2.70	0.03	0.01	1.068	0.835	1.000	0.810	5	13
SR12	118.0	1710	0.041	0.014	2.55	3.02	0.85	0.97	5.27	4.05	0.03	0.01	0.773	0.788	0.742	0.790	12	14
SR13	116.9	2260	0.030	0.014	2.54	2.54	0.85	0.97	3.58	4.10	0.03	0.01	0.685	0.503	0.642	0.405	11	12
SR14	116.0	2270	0.025	0.014	2.56	2.60	0.85	0.98	3.77	4.30	0.03	0.01	0.577	0.502	0.522	0.440	11	13
SR15	114.4	2280	0.026	0.014	2.66	2.62	0.86	1.03	3.97	4.48	0.03	0.01	0.575	0.540	0.540	0.475	10	12
SR16	109.3	2310	0.023	0.030	2.92	2.85	0.87	1.07	3.04	4.53	0.03	0.01	0.474	0.522	0.434	0.465	19	14
SR17	108.5	2320	0.026	0.033	2.80	2.57	0.88	1.01	3.27	4.33	0.03	0.02	0.465	0.517	0.418	0.475	13	15
SR18	105.1	2610	0.020	0.032	3.48	2.70	0.83	0.98	2.97	4.08	0.03	0.02	0.412	0.483	0.358	0.450	47	13
SR19	102.1	2640	0.021	0.021	3.27	2.73	0.84	0.93	2.85	4.13	0.03	0.02	0.412	0.463	0.348	0.430	13	12
SR20	99.9	3200	0.028	0.028	3.05	2.72	0.97	0.94	3.15	3.38	0.03	0.01	0.377	0.385	0.345	0.305	16	13
SR21	99.4	3220	0.041	0.030	3.30	2.90	0.90	0.93	3.18	3.72	0.03	0.02	0.363	0.387	0.373	0.315	22	16
SR22	98.7	3220	0.022	0.032	3.25	2.97	0.97	1.02	3.20	3.77	0.03	0.02	0.402	0.458	0.370	0.340	17	18
SR23	97.9	3220	0.027	0.028	3.20	2.75	0.89	0.94	3.17	3.73	0.03	0.02	0.430	0.387	0.363	0.300	18	15
BW06	9.6	547	0.014	0.014	1.56	1.40	0.48	0.49	0.88	0.96	0.03	0.01	0.077	0.240	0.041	0.067	9	12
Large River Narrative Threshold Rankings	<50th Percentile		≤0.04		≤2.50 ^a		≤0.90		≤3.08		≤0.04		≤0.43		≤0.15 ^d		≤33	
	<75th Percentile		≤0.15		≤3.45 ^b		≤1.20		≤4.14		≤0.11		≤0.87		≤0.30 ^d		≤46	
	<90th Percentile		≤0.299		≤6.25 ^c		≤1.50		≤5.11		≤0.22		≤1.49		>0.30 ^d		≤82	
	<95th Percentile		≤0.404				≤1.70		≤5.72		≤0.26		≤1.90				≤98	
>95th Percentile		>0.404				>1.70		>5.72		>0.26		>1.90				>98		
Source	Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		^a Miltner (2018); ^b Ohio EPA 1999, Median; 2IRQ>Median		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP	

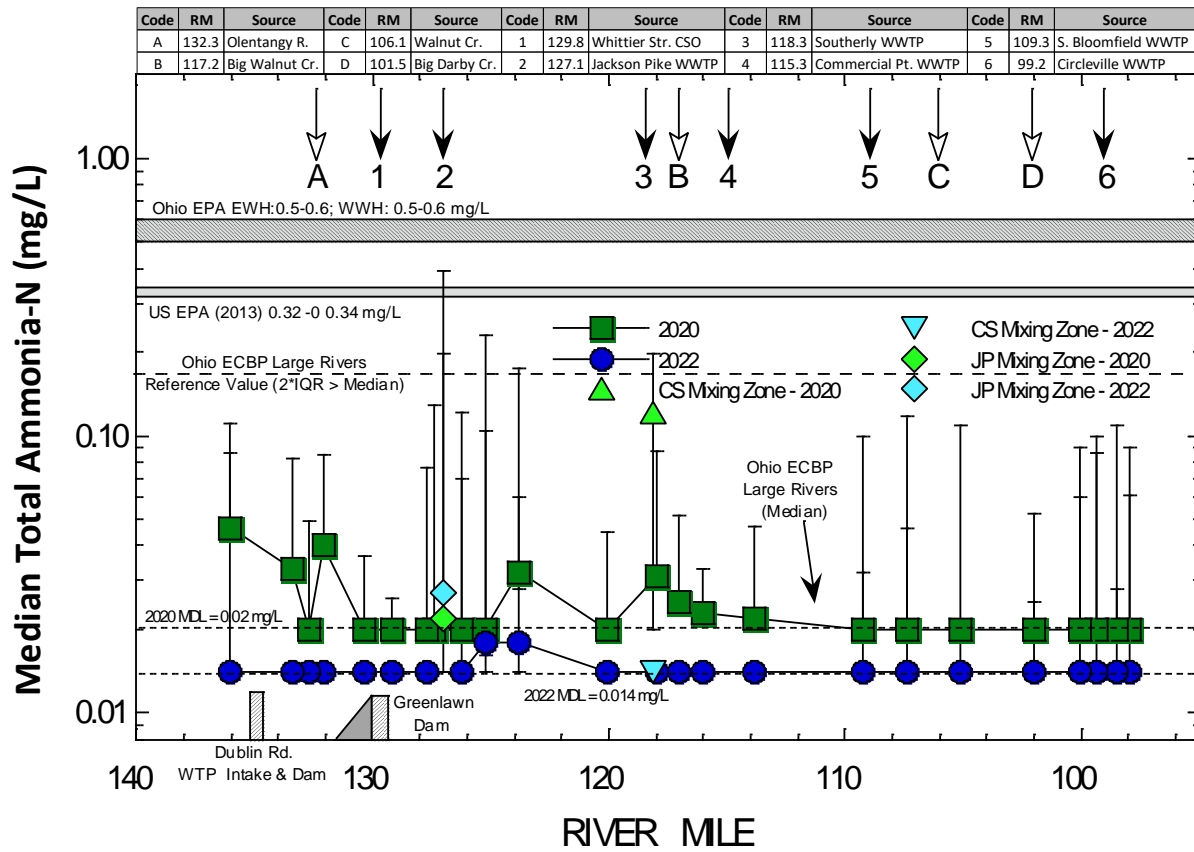


Figure 12. Median, maximum, and minimum ammonia-N values (mg/L) in the middle Scioto River mainstem based on grab samples during June-October, 2020 and 2022. The Ohio EPA WWH and EWH and U.S. EPA (2013) ammonia-N criteria are shown by shaded bars. The ECBP statistical maximum regional reference value is shown by a dashed line. Major tributaries (letters) and discharges (numbers) are indicated along the top of the graphic.

Miltner (2018) 2.5-6.0 mg/L “range of increasing stress”, and the reach between the Greenlawn Dam impoundment (SR05) and SR10 downstream from I-270S exceeded the 6.0 mg/L “overt enrichment” threshold (Figure 13). Spatially, median values between the Greenlawn Dam impoundment (RM 129.9, SR05) downstream to SR10 (RM 123.8) downstream from I-270S reflected inputs related to the Greenlawn Dam and not to any particular point sources. From this point downstream mean values declined from SR10 to downstream from Columbus Southerly to SR16 (RM 109.3) where medians remained below the 2.5 mg/L threshold through the remainder of the mainstem.

Total Kjeldahl Nitrogen (TKN)

Total organic nitrogen as measured by Total Kjeldahl Nitrogen (TKN), an indicator of the living or recently dead fraction of sestonic algae, can be an indicator of organic enrichment. While TKN is not a direct effect parameter, it is indicative of the effects of organic enrichment by nitrogenous biomass. It has proven to be an effective indicator of excessive organic enrichment

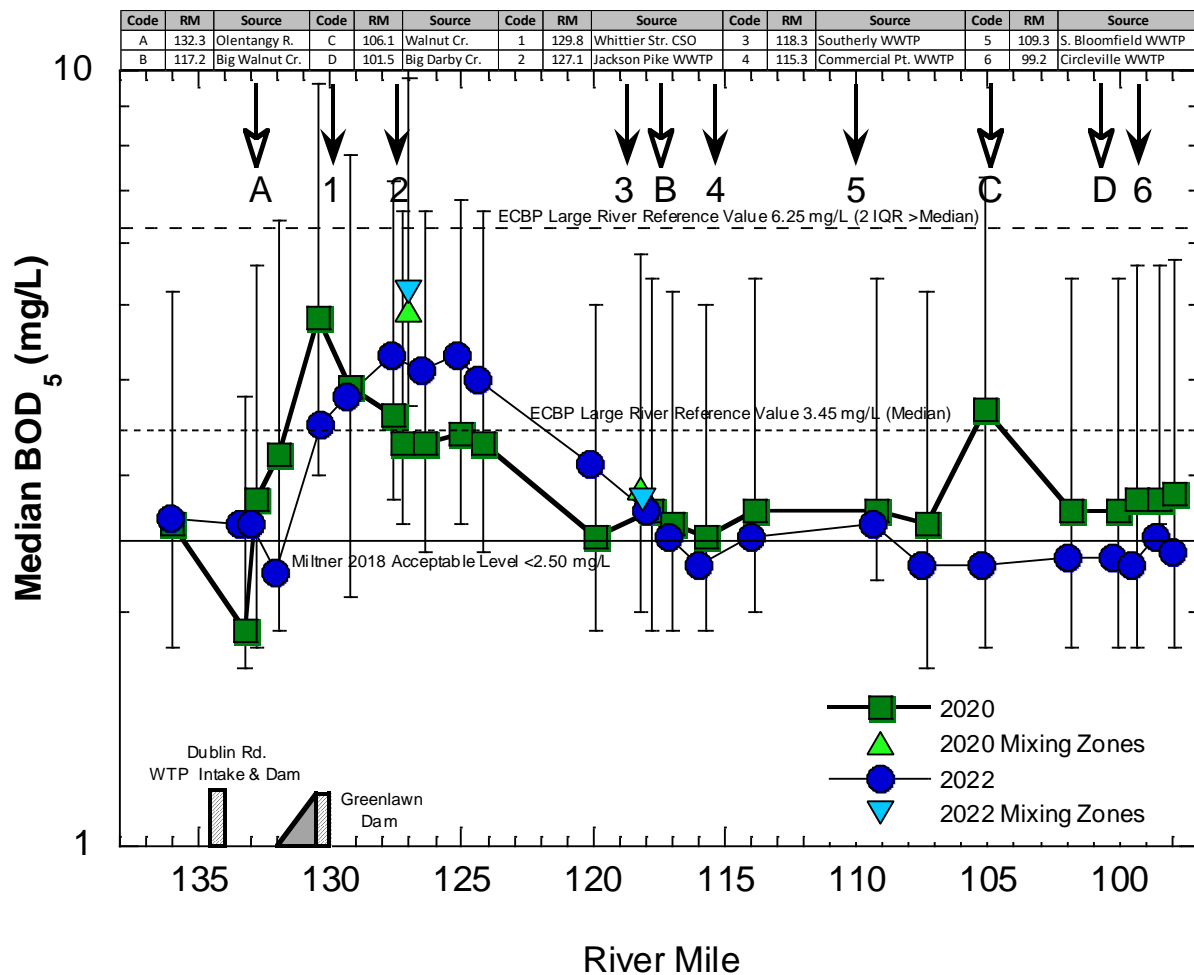


Figure 13. Median BOD5 values (mg/L) in the middle Scioto River mainstem during June-October, 2020. The Ohio ECBP ecoregion large river reference and Miltner (2018) acceptable values are shown by solid and dashed lines. Major tributaries (letters) and discharges (numbers) are indicated along the top of the graphic.

in runoff from urban and suburban nonpoint sources. Miltner (2018) recognized TKN as a “stand alone” indicator of organic enrichment alongside BOD. In terms of assessment thresholds Miltner (2018) considered a TKN value of ≥ 0.75 mg/L to be indicative of over enriched conditions. MBI (2015) in a regional analysis of Southwest Ohio rivers and streams derived a TKN threshold of 1.05 mg/L for WWH and 0.30 for EWH boatable sites. Regional reference levels derived by Ohio EPA (1999) for large rivers in the ECBP ecoregion include a median of 0.90 mg/L and a statistical maximum of 1.50 mg/L.

2022 TKN Results

Mean concentrations of TKN in the middle Scioto River mainstem during 2022 ranged between 0.084 and 1.42 mg/L which was slightly higher than the 0.80-0.90 mg/L range in 2020 (Table 11). The longitudinal patterns were remarkably similar along the mainstem (Figure 14). The 2022 mean and maximum values were elevated in the Jackson Pike mixing zone (RM 127.0,

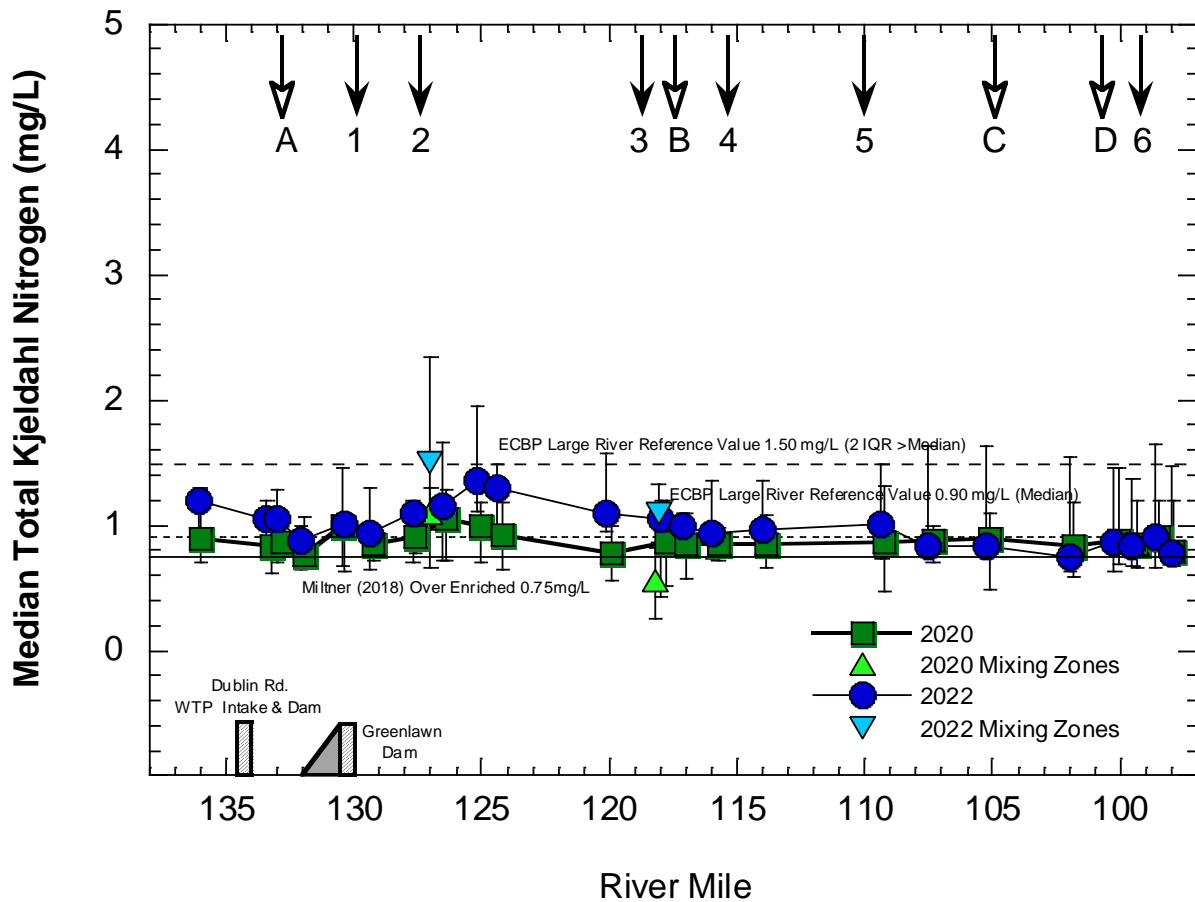


Figure 14. Median, maximum, and minimum TKN values (mg/L) in the middle Scioto River mainstem based on grab samples during June-October, 2022 and 2020. The Miltner (2018) over enriched and Ohio ECBP ecoregion large river reference values are shown by solid and dashed lines. Major tributaries (letters) and discharges (numbers) are indicated along the top of the graphic.

SRJPMZ) and SR09 and SR10. All mean values in 2022 exceeded the Miltner (2018) threshold for overly enriched conditions, but only slightly so in the lower part of the mainstem. Maximum values were only slightly higher than the mean values the highest at 2.00 mg/L in SR09 (125.8).

Nitrate-Nitrogen (NO₃-N)

Nitrate as nitrogen is generally expressed as nitrate-N and along with nitrite-N comprises dissolved inorganic nitrogen in water. The mean and maximum values reported herein are nitrate-N plus nitrite-N, the latter of which was detected at low levels and in only about 10% of the samples collected in the mainstem. Nitrates are not toxic to aquatic life under normal concentrations, are a primary and essential plant nutrient, and can contribute to water quality problems in excessive amounts. Together with the other primary nutrient phosphorus, nitrates in excess amounts can stimulate excessive algal production leading and adverse effects to the

D.O. regime that in turn can adversely affect aquatic life. High nitrates in drinking water supplies can also pose a threat to human health. Sources of nitrates in the middle Scioto River mainstem include agricultural and urban runoff and municipal wastewater resulting from the conversion of ammonia-N as part of the nitrification treatment process.

2022 Nitrate-N Results

Assessment thresholds for nitrate-N are available as regional reference values of 3.08 mg/L (median) and 5.20 mg/L (statistical maximum) for large rivers in the ECBP ecoregion (Ohio EPA 1999a), TMDL targets 2.00 mg/L for WWH and 1.50 mg/L for EWH (Ohio EPA 1999a), and 1.50 mg/L defined by Miltner (2018) as a “starting point” for managing nutrient related effects. Mean nitrate-N values in 2022 mostly exceeded the Miltner (2018) 1.50 mg/L threshold at all except four (4) sites and the 2.00 mg/L WWH TMDL target at all except six (6) sites (Table 11). In 2020 mean values were at or below the Miltner (2018) 1.50 mg/L and Ohio EPA WWH 2.00 mg/L thresholds between Griggs Reservoir and Jackson Pike, and exceeded the same downstream from Jackson Pike. The longitudinal pattern was similar in both years as well with median values in both years increased in the Jackson Pike WWTP mixing zone (RM 127.0, SRJPMZ) and downstream to levels just below the Ohio ECBP regional reference median of 3.08 mg/L (Figure 15). These levels persisted to the Southerly WWTP mixing zone (RM 118.2, SRCMZ) where the mixing zone mean value was 11.3 mg/L in 2020, but only 2.70 mg/L in 2022. Ambient values downstream to RM 114.4 (SR15) only slightly exceeded the regional reference median and were below the statistical maximum then declined to at or below the median for the remainder of the mainstem. The pattern of maximum and minimum values followed a similar longitudinal pattern with differences evident between the mainstem upstream and downstream from the Jackson Pike WWTP. Both years results reflect sustained loadings of nitrate-N from both WWTPs. The upstream results in 2022 especially likely reflected the influence of nitrate-N levels in runoff influenced samples delivered via upstream loadings to Griggs Reservoir to the immediate downstream reach upstream from Jackson Pike. The sustained higher nitrate-N values downstream from the WWTPs is the result of nitrate-N loadings resulting from the nitrification of ammonia-N as part of the AWT process. The significance of the elevated nitrate-N levels in terms of the degree of nutrient enrichment is also part of the Ohio large rivers nutrient effects assessment.

Total Phosphorus (P)

Phosphorus (P) is both an essential and limiting nutrient for plant growth and animal life. It is the most limiting nutrient in freshwater systems primarily to algal growth and biomass. Elevated levels of phosphorus under certain conditions can result in excessive algal growth and activity that in turn affects the D.O. regime and consequently aquatic life. Elevated levels can also stimulate the production of toxic algae that can impact human health, recreation, and elevated P are indirect via how it impacts algal activity and ultimately the D.O. regime. Algal photosynthesis produces oxygen during daylight while algal respiration uses oxygen at night. The difference between daytime and nighttime D.O. value is termed the diel swing the width of which is indicative of nutrient stimulated algal activity. This cycle also impacts pH (high daytime, low nighttime values) which in turn can impact the toxicity of ammonia especially at higher pH

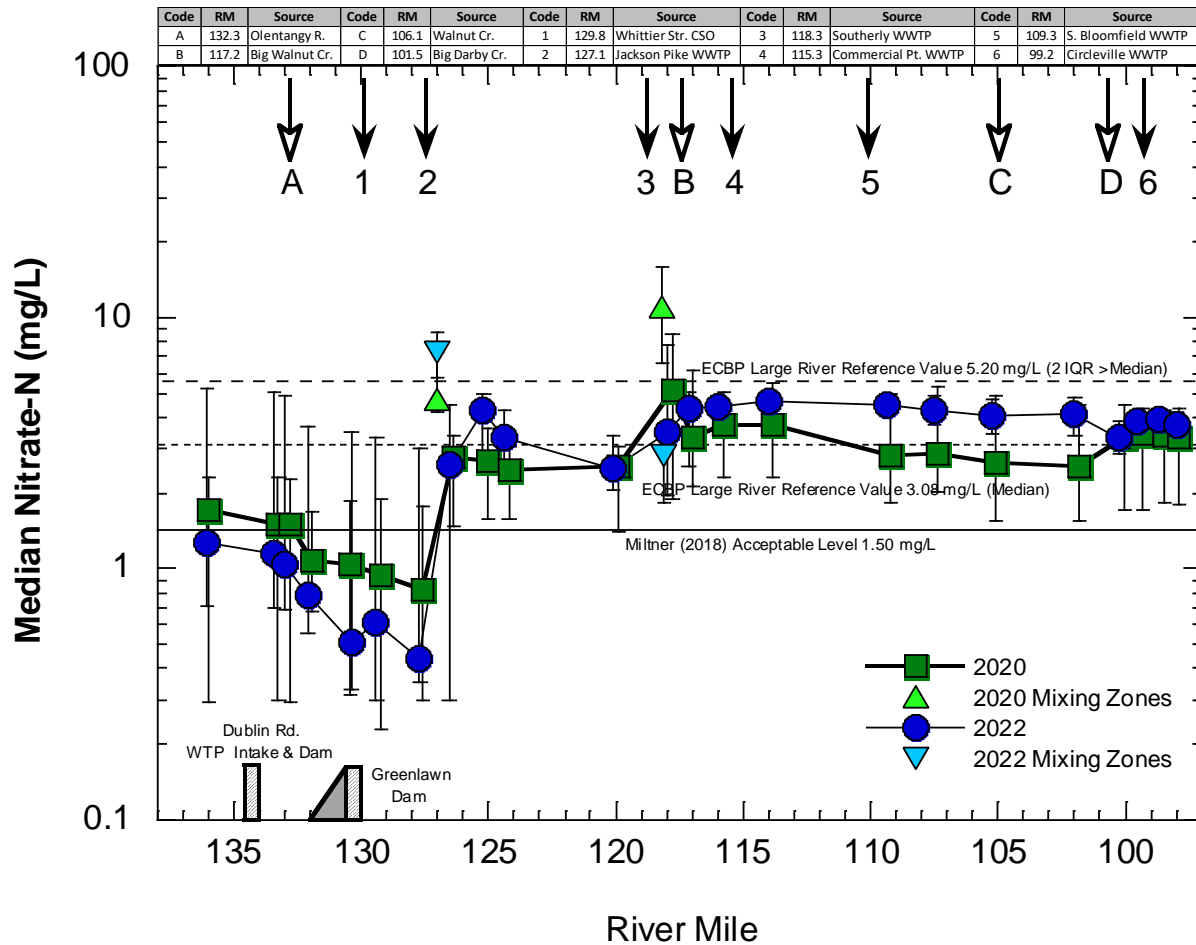


Figure 15. Median, maximum, and minimum nitrate-N values (mg/L) in the middle Scioto River mainstem based on grab samples during June-October, 2020 and 2022. The Miltner (2018) “starting point” and Ohio ECBP ecoregion large river reference values are shown by solid and dashed lines. Major tributaries (letters) and discharges (numbers) are indicated along the top of the graphic.

levels (i.e., >8.0). This the management of P loads from both point and nonpoint sources is an public water supplies. In flowing water bodies such as rivers and streams the adverse impacts of emerging water quality management issue. Sources of phosphorus in the middle Scioto River mainstem primarily include agricultural and urban runoff and municipal wastewater. The dynamics of how water quality and biological condition are affected by each is complex and related to physical factors such as flow (including retention time), habitat, and temperature (Ohio EPA 1999a; Miltner 2018).

2022 Total P Results

Assessment thresholds for total P are available as regional reference values of 0.430 mg/L (median) and 1.308 mg/L (statistical maximum) for large rivers in the ECBP ecoregion (Ohio EPA 1999a), TMDL targets of 0.300 mg/L for WWH and 0.150 mg/L for EWH, and 0.130 mg/L defined by Miltner (2018) as the threshold for over-enrichment. Mean total P values in 2022 all exceeded the Miltner (2018) 0.130 mg/L and Ohio EWH 0.150 mg/L thresholds at all sites in the

mainstem (Table 11). The longitudinal pattern in both years was similar with the largest increases at Jackson Pike, but with local reach differences (Figure 16). Mean values increased sharply to >2.600 mg/L in the Jackson Pike WWTP mixing zone (RM 127.0, SRJPMZ) and remained well above the Ohio WWH target of 0.300 mg/L ranging between 0.385-1.170 mg/L downstream through the entire mainstem study area. The Southerly WWTP had no effect on these values with the mixing zone (RM 118.2, SRCMZ) mean value showing no difference with upstream or downstream values and with the maximum well below that at Jackson Pike. Unlike 2020, the maximum values upstream from Greenlawn Dam were much lower downstream to Jackson Pike. The difference between maximum and minimum values was similar at all ambient sites downstream to Circleville.

2022 Ortho P

The 2022 samples were analyzed for both total P and dissolved P as orthophosphate, the latter being the form that is the most readily available to plants and algae. A comparison of the mean values for each year showed lower median values in 2022 between Griggs Dam and Greenlawn Dam impoundment with the largest differences between ortho and total P ranging from 0.233-0.237 (Table 11). Ortho P levels in 2022 increased below the Jackson Pike WWTP tracking the general trend of total P with differences ranging between 0.00-0.193. In 2020 the differences were consistently <0.10 mg/L downstream from the WWTP discharges. A similar general longitudinal trend between 2020 and 2022 was observed especially downstream from Jackson Pike which was the principal source of both total and ortho P in both years (Figure 16).

Chlorophyll a

Chlorophyll allows photosynthesis in plants (including algae) by using sunlight energy to convert simple molecules into organic compounds under aerobic conditions. Chlorophyll a is the predominant type of chlorophyll found in green plants and algae. Sestonic is measured as biomass per unit volume in $\mu\text{g/L}$ and benthic is measured as biomass per unit area in mg/m^2 . In flowing waterbodies the relationship between nutrient enrichment and chlorophyll a levels is complex. The lack of a relationship between nutrient levels and chlorophyll a is due in part to the delayed effect in algae being able to utilize the excess nutrients to produce excessive chlorophyll a biomass. As a result algal biomass as measured by chlorophyll a will occur with distance downstream from a nutrient source with factors such as flow volume, velocity, and variability influencing this dynamic. Chlorophyll a levels can vary widely within and between seasons again depending on factors such as the flow regime and temperature in addition to nutrient loadings and availability. The water quality impacts of excessive algae as measured by chlorophyll a include a wider swing in the diel D.O. cycle, aesthetic impacts, and human health risks when toxic forms of algae are present. The principal emphasis in the 2020 and 2022 surveys is on aquatic life impacts due to modifications to the D.O. regime.

Chlorophyll a was sampled as both sestonic and benthic forms in 2020 and 2022. Sestonic chlorophyll a was collected as part of the grab sampling during June-October and benthic chlorophyll a was collected during the short-term deployment of the Datasonde monitors. Mean, maximum, and minimum sestonic chlorophyll a biomass in $\mu\text{g/L}$ and benthic chlorophyll

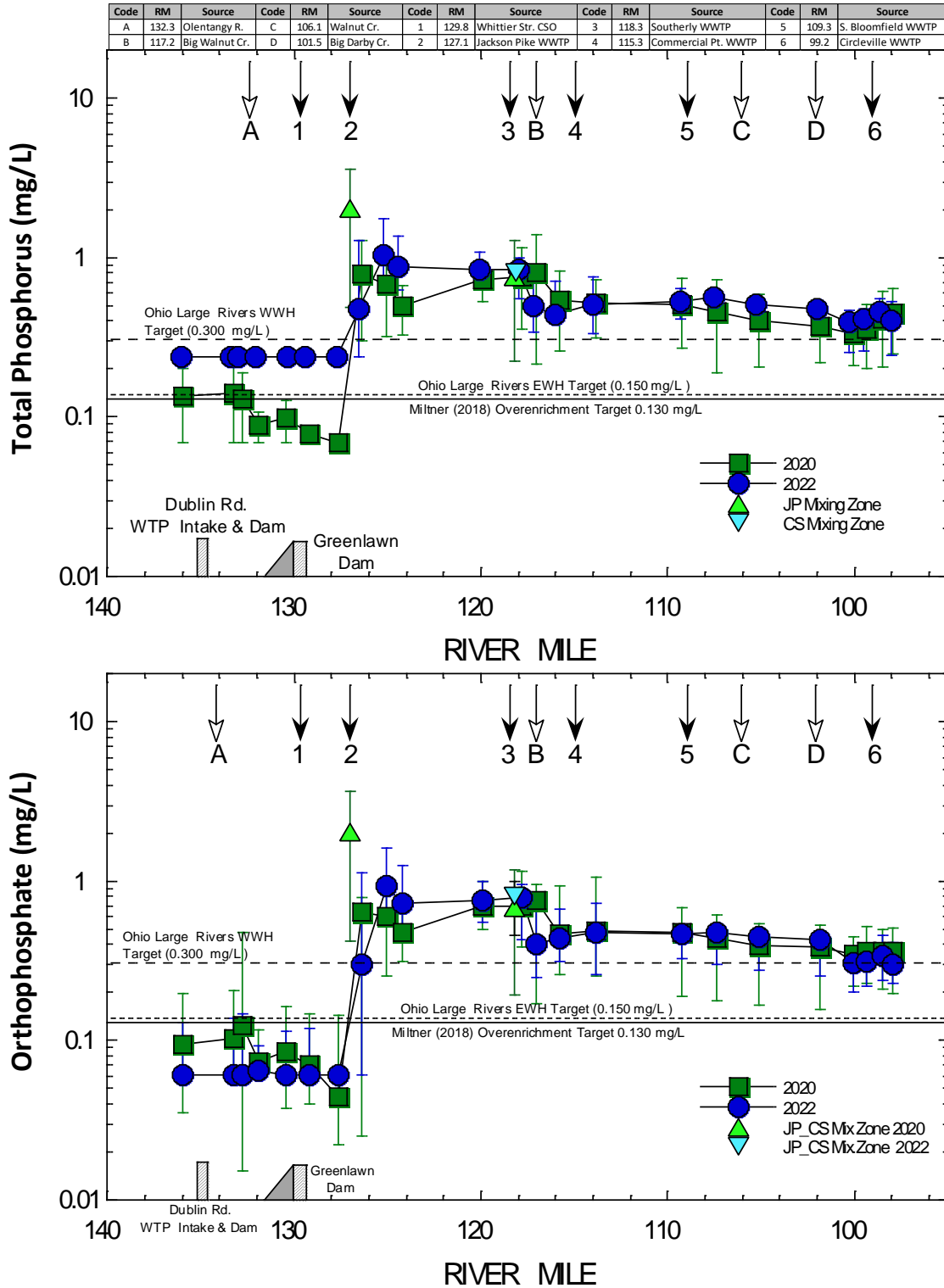


Figure 16. Median, maximum, and minimum total P (upper) and ortho P values (lower; mg/L) in the middle Scioto River mainstem based on grab samples during June-October, 2020 and 2022. The Miltner (2018) over-enrichment and Ohio WWH and EWH TMDL target values are shown by solid and dashed lines. Major tributaries (letters) and discharges (numbers) are indicated along the top of the graphic.

a biomass in mg/m^2 appear together in Figure 17. The longitudinal pattern in mean sestonic chlorophyll a values in 2020 initially resembled that of total and ortho phosphorus (Figure 16), but there are important differences. The highest levels of mean sestonic chlorophyll a occurred between the Olentangy River (RM 132.2) and the site immediately upstream from the Jackson Pike WWTP (RM 127.1) whereas phosphorus increased downstream from Jackson Pike. Relative to upstream levels, mean sestonic chlorophyll a declined downstream from Jackson Pike and leveled off through the remainder of the mainstem and were well below the enriched threshold of $30 \mu\text{g}/\text{L}$. Maximum sestonic chlorophyll a levels showed a somewhat different pattern by exceeding the enriched threshold of Miltner (2018) at nearly every site downstream from Jackson Pike and being highest downstream from Walnut Creek and remaining at those levels through the remainder of the lower mainstem in 2020. A similar longitudinal pattern was observed in 2022 with the mean at SR07 (127.7) at Frank Rd., SR08 (RM 126.2), and SR09 (RM 125.8) downstream from Jackson Pike exceeding the enriched threshold, the only sites to do so in either year. The exceedances seem to be more related to an upstream source independent of Jackson Pike. Maximum values were highest between SR03 (132.7) and SR08 (RM 126.2), after which maximum values declined, and then increasing again downstream from Walnut Creek and remaining at those levels through the remainder of the lower mainstem in 2022. The elevated maximums and mean values in 2022 are likely due to a combination of sources upstream from Jackson Pike and low flows and impoundment that increase retention time. The downstream maximums are a result of the net total inputs from the urban footprint of Columbus coupled with loadings from Jackson Pike. The results also demonstrate the variability of sestonic chlorophyll a that is likely related to the variable flow conditions that occurred throughout the 2020 and 2022 summer-fall index period. None of the maximum values in either year exceeded the over-enriched threshold of $100 \mu\text{g}/\text{L}$.

The longitudinal pattern of benthic chlorophyll a biomass in 2020 somewhat followed the median sestonic chlorophyll a pattern. In the upper mainstem the biomass was highest in the Greenlawn Dam impoundment (RM 129.9, SR05), but not markedly higher than adjacent sites. The values were well below the Ohio SNAP method (Ohio EPA 2015b) enriched threshold of $162 \text{mg}/\text{m}^2$. The highest values were measured in the lower mainstem downstream from Circleville at RM 99.4 (SR21) and RM 97.9 (SR23) with both values at or just above the enriched threshold. Benthic chlorophyll a was about one-half the values observed in 2020 with a maximum of only $70 \text{mg}/\text{m}^2$ in 2022 compared to a maximum of $175 \text{mg}/\text{m}^2$ in 2020. The position of the maximums was also different occurring at the downstream most two sites in 2020 and at SR13 (RM 116.8) downstream from Big Walnut Creek. The longitudinal trend in 2020 was more typical with the highest values occurring well downstream of the highest loadings of phosphorus, but the 2022 trend reflecting a more random pattern and not seemingly related to any specific source.

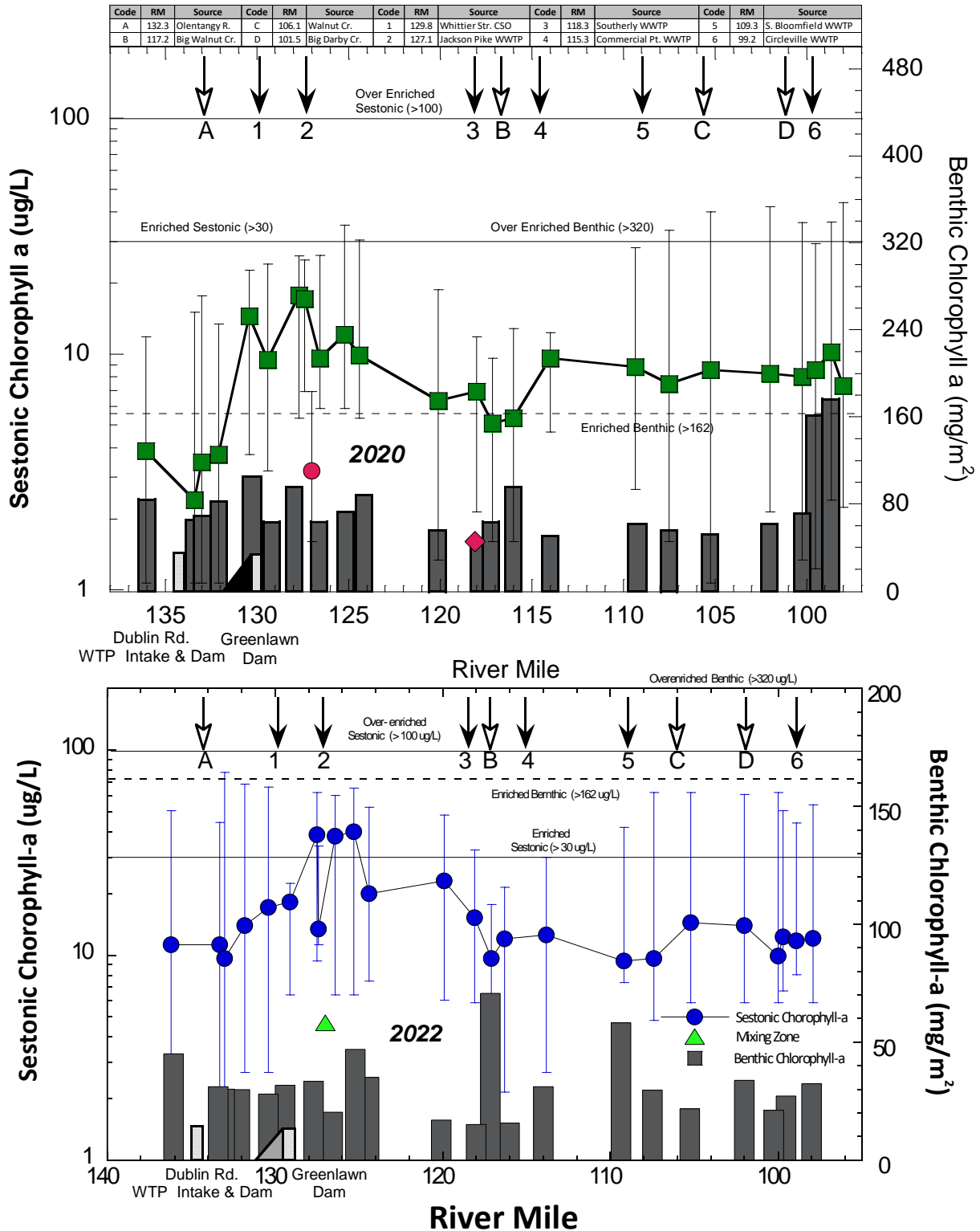


Figure 17. Median, maximum, and minimum sestonic chlorophyll a values (y1 axis; $\mu\text{g/L}$) and benthic chlorophyll a biomass (y2 axis histogram; mg/m^2) based on grab samples in the middle Scioto River mainstem during June-October, 2020 (upper) and 2022 (lower). The Miltner (2018) enriched and over-enriched thresholds are shown for each by solid and dashed lines. Major tributaries (letters) and discharges (numbers) are indicated along the top of the graphic

Scioto River Mainstem Nutrient Effects Assessment

The impact of nutrients on aquatic life has been well documented (Allan 2004), but the derivation of modernized nutrient criteria and their form and application are only just now emerging. Because of the widely varying efforts to develop nutrient criteria by the States, conflicting U.S. EPA oversight, and the potential cost of additional nutrient controls it has been a controversial issue (Evans-White et al. 2014). Unlike toxicants, the influence of nutrients on aquatic life is indirect and primarily via their influence on algal photosynthesis and respiration and the resulting increase in the magnitude of diel D.O. swings and by the biochemical oxygen demand exerted by algal photosynthesis, respiration, and decomposition. Nutrients can also affect food sources for macroinvertebrates and fish and the response of aquatic life to elevated nutrients is co-influenced by habitat (e.g., substrate composition, channel morphology), stream flow (e.g., scouring and dilution), temperature, and exposure of the water column to sunlight. Ohio has developed a technical approach to evaluate nutrient effects in large rivers (Miltner 2018) and is in the midst of a process to develop modernized nutrient water quality criteria. At this time an approach for developing nutrient water quality criteria for large rivers was described as part of an Early Stakeholder Outreach process in 2018 (Ohio EPA 2018) to revise (OAC 3745-1-3611). However, no formal proposal for revising these criteria has been made at this time.

The Ohio Large Rivers approach described by Miltner (2018) offers assessment thresholds for each of the variables included in a combined nutrients effect assessment (Table 12) for three states of eutrophication – acceptable, enriched, and over-enriched. The enriched and over-enriched states also imply that biological assemblages are “stressed” for enriched and impaired for over-enriched along with the over-enriched state being “aesthetically obvious”. For the latter, the Ohio EPA (2018) ESO presentation showed visual signs of over-enrichment based on color and clarity with enriched conditions at $>100 \mu\text{g/L}$ and nuisance conditions occurring at sestonic chlorophyll a levels of $>165 \mu\text{g/L}$. The combined effects of nutrient enrichment were assessed to integrate the preceding descriptions of the concentrations of each of the key nutrient related parameters with measures of algal productivity, habitat, and the numeric biocriteria. A multi-parameter approach using elements of the Ohio large rivers methodology (Miltner 2018), the proposed eutrophication standard box model (Ohio EPA 2018), the Ohio EPA SNAP (2015b) methodology, and the primacy of the biocriteria for determining aquatic life use attainment status (OAC 3745-1-07[C]). These were used in a combined approach to evaluate nutrient effects on the eutrophication status and aquatic life use attainment in the middle Scioto River mainstem.

The results are detailed in a matrix that shows the biocriteria indices, the QHEI score, benthic and sestonic chlorophyll a (as biomass), the maximum and minimum D.O. (based on Datasondes), the width of the highest daily diel D.O. swing, mean BOD5, ortho P, TKN, TSS, nitrate-N, an overall rating of the degree of nutrient enrichment based on the frequency and magnitude of exceedances of thresholds for the aforementioned indicators and parameters

¹¹ OAC 3745-1-36 is not currently listed in the Ohio WQS and will be proposed as a new rule.

Table 12. Nutrient assessment thresholds for nutrient and related parameters and indicators developed by Miltner (2018), Ohio EPA (2015b), and Ohio EPA (2018) for assigning eutrophication status to Ohio large rivers as acceptable, enriched, and over-enriched and as used to assess the status of sites in the middle Scioto River mainstem study area in 2020 and 2022.

Parameter	Acceptable	Enriched	Over-Enriched	Source
Chlorophyll a ($\mu\text{g/L}$) ^a	<30	30-100 rapid increase in BOD5 and 24-h D.O. Range	≥ 100 BOD5 and TKN always highly elevated	Miltner (2018) Table 6
Chlorophyll a ($\mu\text{g/L}$) ^a	<30	100 with aesthetic impacts apparent	≥ 165 with nuisance conditions apparent	Ohio EPA (2018) Slide 2
Chlorophyll a (mg/m^2)	<182	182-320	>320	Ohio EPA SNAP (2015b)
BOD5 (mg/L)	<2.5	2.5-6.0 range of increasing stress	≥ 6.0	Miltner (2018) Table 6
TKN (mg/L)	NA	NA	≥ 0.75	Miltner (2018) Table 6
24-hour D.O. (mg/L)	<7	7-9 rapid increase in BOD5	≥ 9	Miltner (2018) Table 6
TSS (mg/L)	NA	>25 screening level under stable hydrograph	NA	Miltner (2018) Table 6
Total P (mg/L)	≤ 0.130	>0.130	NA	Miltner (2018) Text
Nitrate-N (mg/L)	1.500 "starting point"	NA	NA	Miltner (2018) Text

Footnotes: a - sestonic chlorophyll a as concentration; b - benthic chlorophyll a as biomass.

with aquatic life use attainment status as the controlling factor (Table 13). Ortho P was used in 2022 lieu of total P because the MDL used for the latter in 2022 exceeded the P threshold of 0.13 mg/L. Although the longitudinal and temporal trends in the chemical indicators and their relationship to the nutrient enrichment thresholds described by Miltner (2018) has already been thoroughly described individually, the box model matrix allows for an aggregate assessment of the contributing variables along the longitudinal pollution gradients present in the middle Scioto River. The overall degree of nutrient enrichment effects are represented by three narrative ratings of acceptable, enriched, or over enriched contingent on the degree to which each of the parameters and indicators exceeded their respective thresholds in accordance with Miltner (2018) against the attainment status of the applicable aquatic life use designation. Full attainment of the applicable aquatic life use resulted in an acceptable rating in keeping with OAC 3745-1-07(C)(1).

All except one of the 23 sites evaluated had an acceptable result (Table 13). The Greenlawn Dam impoundment was rated as over-enriched due to the impairment of the MWH use along with the combination of a highly elevated diel D.O. swing, a very high maximum D.O., and elevated TKN, BOD5, and TSS. All sites downstream from the Griggs Reservoir (RM 136.5, SR01) dam to downstream stream from the Olentangy River confluence (RM 133.0, SR03) had elevated or highly elevated maximum D.O. and elevated diel D.O. swings, nitrate-N was highly elevated at the three upstream most sites, but other parameters had either no or only slightly elevated results. These sites were all rated as acceptable based on full attainment of the WWH use designation. Ortho P was consistently elevated downstream from Jackson Pike and 10 sites downstream from Greenlawn Dam to the end of the study area had elevated maximum D.O. with highly elevated values at SR21 and SR23 below Circleville. Elevated diel D.O. swings were limited to two sites, SR11 (RM 120.1) and SR 21 (RM99.4), but all sites except one were in full attainment of the existing WWH use designation with all mainstem sites and Big Walnut creek in full attainment of EWH. The site at SR09 (RM 125.3) was in partial attainment of WWH due to a non-nutrient related cause hence it was deemed acceptable.

Two of the chemical parameters, BOD5 and TKN, had elevated levels throughout the middle Scioto River mainstem study area and did not exhibit any strong association with a source or sources of nutrient loadings the same as in 2020. Elevated levels of ortho P and nitrate-N were strongly associated with the Jackson Pike WWTP discharge being markedly elevated above the Miltner (2018) thresholds and persisting downstream through the mainstem study area. Levels of each in Big Walnut Creek were well within the acceptable thresholds. All except three (3) of the sestonic chlorophyll a levels that corresponded to the Datasonde deployments were well below the 30 µg/L acceptable level and maximum values measured outside that period were just above that threshold as detailed previously. The three (3) sites that exceeded the 30 µg/L enrichment threshold occurred just upstream and downstream of the Jackson Pike discharge and are seemingly more associated with upstream input to the mainstem. Benthic chlorophyll a biomass was well below the Ohio SNAP threshold at all sites being much lower than 2020 levels which had one value in the enriched range. None of the chlorophyll a levels indicated any issues with aesthetic quality.

Table 13. Results of applying Ohio large river nutrient assessment and box model to 23 sites in the 2022 middle Scioto River mainstem study area. Thresholds for how each parameter reflects the degree of nutrient enrichment effects and are at the bottom of the matrix.

Site ID	River Mile (Fish/Macros)	Drainage Area (sq. mi.)	Current Aquatic Life Use ^a	IBI ^b	MIwb ^b	ICI ^b	Aquatic Life Use Status ^c	QHEI	Benthic Chloro-phyll-a (mg/m2)	Sestonic Chloro-phyll-a (ug/L)	BOD (mg/L)	Min. DO (mg/L)	Max. DO (mg/L)	DO Swing (mg/L)	TKN (mg/L)	TSS (mg/L)	Ortho P (mg/L)	Nitrate (mg/L)	Overall Nutrient Box Model Status
Scioto River Mainstem - WWH (Existing)																			
SR01	136.05/136.20	1050	WWH	46	9.6	Good	FULL	88.0	46.8	19.1	3.37	3.45	12.80	8.54	1.16	12.00	0.061	2.29	Acceptable
SR02	133.40/133.40	1070	WWH	44	9.6	MG ^{ns}	FULL	84.0	31.8	18.9	2.88	4.78	14.29	7.66	1.00	12.00	0.061	2.21	Acceptable
SR03	133.00/132.80	1070	WWH	52	9.6	34 ^{ns}	FULL	87.0	30.3	26.3	3.05	7.48	17.25	8.79	0.99	12.17	0.061	2.13	Acceptable
SR04	132.10/132.10	1610	WWH	42	8.7	40	FULL	68.5	28.3	20.9	2.55	7.77	15.82	7.68	0.84	12.33	0.064	1.53	Acceptable
Scioto River Mainstem - MWH(Existing)																			
SR05	130.40/130.10	1620	MWH-I	36	8.4	6*	NON-VP	57.0	27.6	24.3	3.62	10.51	24.18	12.60	0.95	12.33	0.061	1.44	Over Enriched
Scioto River Mainstem - WWH(Existing)																			
SR06	129.40/129.00	1620	WWH	47	9.9	Good	FULL	86.3	32.9	16.3	3.32	3.53	12.99	5.12	0.95	15.60	0.061	1.57	Acceptable
SR07	127.70/127.70	1620	WWH	49	10.6	42	FULL	85.5	34.0	35.1	4.12	5.33	12.79	5.98	1.02	14.00	0.061	0.98	Acceptable
SR08	126.55/126.50	1630	WWH	44	9.8	40	FULL	85.0	20.7	32.9	4.37	6.02	11.91	4.58	1.17	15.58	0.940	2.33	Acceptable
SR09	125.20/125.40	1640	WWH	36*	8.9	40	PARTIAL	61.5	45.2	33.0	4.30	6.13	13.24	5.54	1.42	13.50	0.930	4.05	Acceptable
SR10	124.40/124.50	1670	WWH	50	10.0	40	FULL	80.3	35.5	23.6	4.08	6.34	11.93	4.55	1.27	19.00	0.720	3.37	Acceptable
SR11	120.10/119.30	1700	WWH	48	10.5	50	FULL	86.0	17.1	25.0	3.24	5.90	14.78	6.70	1.18	14.50	0.765	2.67	Acceptable
SR12	118.00/118.00	1710	WWH	47	10.2	44	FULL	72.5	15.1	17.2	3.02	6.58	13.31	5.22	0.97	14.00	0.790	4.05	Acceptable
Scioto River Mainstem - EWH (Existing)																			
SR13	117.15/116.90	2260	EWH	50	10.5	48	FULL	84.0	70.7	9.5	2.54	7.07	11.60	3.98	0.97	12.00	0.405	4.10	Acceptable
SR14	116.00/116.00	2270	EWH	49	10.7	52	FULL	86.5	15.6	11.9	2.60	6.80	12.19	4.54	0.98	12.67	0.440	4.30	Acceptable
SR15	114.00/115.00	2280	EWH	48	10.3	52	FULL	84.5	33.2	14.4	2.62	6.80	12.25	4.36	1.03	12.33	0.475	4.48	Acceptable
SR16	109.35/109.20	2310	EWH	50	10.5	54	FULL	84.0	58.5	17.0	2.85	6.50	11.38	3.91	1.07	13.67	0.465	4.53	Acceptable
SR17	107.50/108.50	2320	EWH	48	10.2	42	FULL	77.0	30.7	21.0	2.57	6.92	11.89	3.30	1.01	14.50	0.475	4.33	Acceptable
SR18	105.25/106.00	2610	EWH	48	9.6	56	FULL	79.8	21.6	21.8	2.70	7.19	11.62	2.92	0.98	12.67	0.450	4.08	Acceptable
SR19	102.00/102.00	2640	EWH	49	9.8	50	FULL	81.5	33.9	21.8	2.73	6.21	11.85	3.86	0.93	12.33	0.430	4.13	Acceptable
SR20	100.24/100.10	3200	EWH	50	9.5 ^{ns}	54	FULL	93.5	21.5	21.9	2.72	6.77	12.58	4.68	0.94	12.50	0.305	3.38	Acceptable
SR21	99.52/99.40	3220	EWH	48	9.5 ^{ns}	52	FULL	89.8	27.3	20.5	2.90	6.33	20.38	12.49	0.93	16.33	0.315	3.72	Acceptable
SR23	98.01/97.90	3220	EWH	51	10.0	50	FULL	92.5	30.3	21.0	2.75	6.53	15.05	5.92	0.94	14.50	0.300	3.73	Acceptable
Big Walnut Creek - EWH (Existing)																			
BW06	9.65/9.60	540.00	EWH	49	10.8	46	FULL	83.5	22.0	1.6	1.60	6.97	9.26	2.25	0.49	12.00	0.067	0.96	Acceptable
Narrative Threshold Rankings	Exceptional	48-60	>9.6	>42	FULL	>75	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Acceptable
	Good	38-43	8.0-9.1	32-40	FULL	60-74	<182	<30	<2.5	>4	<12	<7.0	<0.75	<20	<0.13	<1.56			Acceptable
	Fair	26-37	5.8-7.9	14-30	PART./NON	46-59	182-320	30-100	2.5-5.9	<4	>12	7.0 - 8.9	>0.75	>20	>0.13	>1.56			Enriched
	Poor	19-25	4.0-5.7	8-12	NON-Poor	30-45	>320	>100	>6.0	<2	>14	>9.0	>0.75						Over Enriched
	Very Poor	12-18	<4.0	0-6	NON-V.Poor	<30													
Footnotes:	^a - as codified in OAC 3745-1-07, Table 7-1; ^b - Nonsignificant departure of 4 units for IBI and ICI, 0.5 MIwb units allowed for attainment; ^c - FULL - all biocriteria attain; PARTIAL - one or two biocriteria fail to attain; NON - no biocriteria attain or one assemblage with poor or very poor narrative.																		

The results in the reach upstream from the Greenlawn Dam remain influenced by habitat (impoundment), flow alterations, and background levels of nutrients and the other nutrient related parameters that emanate from Griggs Reservoir. The comparative lack of flow in the reach between the Dublin Rd. WTP dam and intake and the Scioto River likely played a role in exacerbating what amounts to comparatively low levels of nutrients, especially ortho P under summer normal flows. The WTP can withdraw almost all the flow in this reach if the mainstem resulting in longer retention times downstream to the Olentangy River confluence. The quantity of flow is not an issue between Griggs Reservoir and the WTP intake, but the accumulation of nonpoint source loadings and their effects in the reservoirs could be an issue especially under longer retention times in the Griggs and O'Shaughnessy Reservoirs. The immediate results were apparent in the low minimum D.O. levels measured at RM 136.50 (SR01) during the Datasonde deployment, but with no significant response by the biota in terms of WWH use attainment. The macroinvertebrate assemblage at this site was exceptional in 2022 compared to the marginal results in 2020 that were within the range of insignificant departure from the ICI WWH biocriterion, but the fish assemblage indicated exceptional quality.

The Olentangy River exerts a significant influence on the flow regime of the Scioto River mainstem with both elevated and minimum flows being prolonged under certain conditions and as controlled by releases from the Delaware Reservoir to maintain the summer recreation pool. This affects flows in the Scioto between the Olentangy confluence and the Jackson Pike WWTP during extended wet or dry periods in the upper Olentangy River watershed, the latter of which would likely exacerbate nutrient impacts under. The periodic elevated flows likely ameliorate nutrient impacts through dilution and reduced retention times. In 2022 there were at least four (4) peaks in flow above the median for the May-November period. The lowermost reach of the middle Scioto River mainstem downstream from Walnut Creek (RM 106.1) exhibited a more traditional pattern of point source related enrichment impacts with the maximum D.O. and diel swing indicators increasing to elevated and highly elevated about six (6) miles downstream from the location of the D.O. "sag" which historically has occurred just upstream from Walnut Creek. Nevertheless, the aquatic life attainment status was solidly full EWH from the Big Walnut Creek confluence (RM 117.2) to the downstream most site (RM 97.9, SR23) below Circleville in 2022 similar to what was first observed in 2015, 2020 and again in 2022. Any impacts beyond this point in the mainstem have not been recently investigated so the extent of how far downstream these effects persist is unknown.

Urban Parameters

Urban parameters include the common ions chloride and sulfate, conductivity, total dissolved solids, and common heavy metals such as copper, lead, and zinc. Total suspended solids can be included in this group because of its widespread use as an indicator of urban runoff and stormwater. These parameters can become highly elevated in urbanized watersheds and are indicative of diverse sources and activities that exemplify urban land uses. Grab temperature and pH were also included since they straddle the conventional and urban parameters.

Chlorides

In temperate climates such as exist in central Ohio, dissolved materials in the form of chlorides are an emerging problem because they accumulate in soils and shallow groundwater and have been documented to reach concentrations that can threaten and impair aquatic life. Of particular concern in urban areas with high road density is the concentration of chlorides from winter road salt applications and point source loadings from water treatment blowdown. Chlorides have been documented to be increasing steadily in freshwaters including large rivers (Mullaney et al. 2009; Kelly et al. 2012). Chlorides do not exhibit a simple runoff and export mode of effect, but rather accumulate in near surface groundwater (Kelly 2008), soils, and land surfaces adjacent to streams. Seasonal studies have shown that elevated summer concentrations are correlated with higher and acute concentrations during late winter and spring periods (Kaushal et al. 2005). Research in New England (Kaushal et al. 2005) and Minnesota (Novotny et al. 2008) show that chlorides can accumulate in watersheds and that there is a strong association between high winter and elevated summer concentrations. Novotny et al. (2008) identified that 78% of the road salt applied in a Minnesota watershed accumulated in a given year and contributed to an increase in summer chloride concentrations. Ohio does not have a chloride water quality criterion for the protection of aquatic life, although there is a maximum contaminant level of 250 mg/L that applies to public water supplies. U.S. EPA (1988) recommends a water quality criterion of 230 mg/L for the protection of aquatic life. A more recent Ohio study that examined several decades of ambient water quality data against biological assemblage response (Miltner 2021) recommends a “safe” level for chloride at 52 mg/L for the protection of high quality waters. This value is in line with a derived values of 68.4 mg/L for WWH and 32.9 mg/L for EWH attainment at boatable sites in Southwest Ohio (MBI 2015).

2022 Chloride Results

Mean chloride values increased from a low of 36 mg/L immediately downstream from Griggs Dam (RM 136.50, SR01) increasing to 57 mg/l downstream from the Olentangy River confluence (RM 132.3) between RM 132.1 (SR04) to 64 mg/L just upstream from the Jackson Pike WWTP at RM 127.4 (SR08.2; Table 14) exceeding the regional reference median value of 45.5 mg/L. Values increased to their highest level of 100 mg/L downstream from Jackson Pike and remaining elevated about the 95%ile regional reference value downstream to SR19 (RM 102.1) after which levels only declined by 1-9 mg/L through the downstream end of the study area. All of the values except two (both 51 mg/L) between SR04 (RM132.1) and SR23 (RM 97.9) exceeded the Miltner (2021) hazard level of 52 mg/L. Chloride levels were lower in 2020 ranging from a low of 26 mg/L immediately downstream from Griggs Dam (RM 136.50, SR01) and steadily increasing at the next two sites and either reaching or just above and below the regional reference median value of 45.5 mg/L downstream from the Olentangy River confluence (RM 132.3) between RM 132.1 (SR04) to just upstream from the Jackson Pike WWTP at RM 127.4 (SR08.2; Figure 20). Values increased sharply to above the Miltner (2021) hazard level of 52 mg/L and just above the maximum regional reference value of 68.5 mg/L at all sites downstream from the Jackson Pike WWTP (RM 127.1) to RM 108.5 (SR17) just upstream from Walnut Creek (RM 106.1). Mean values declined steadily and below the maximum reference threshold through the remainder of the middle mainstem, but remained

Table 14. Mean values for urban related parameters in the middle Scioto River mainstem in 2020 and 2022. Bold italic values are the highest between the two years. Values are color coded in accordance with the legend at the bottom.

Site ID	River Mile	Drainage Area (mi. ²)	Temperature mg/L (Mean)		pH S.U. (Mean)		Chloride, Total mg/L (Mean)		Conductivity μS/cm (Mean)		Total Dissolved Solids mg/L (Mean)		Total Cu (Mean) μg/L		Total Zn (Mean) μg/L	
			2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022
<i>Scioto River</i>																
SR01	136.5	1050	21.2	22.7	<i>7.96</i>	7.95	28	36	470	571	297	378	12.9	2.8	7.4	27.2
SR02	133.4	1050	21.5	23.6	8.03	8.12	30	37	471	557	287	393	2.5	3.4	5.3	9.5
SR03	132.7	1070	21.6	23.7	8.06	8.18	33	37	490	560	290	390	2.6	2.9	6.5	18.4
SR04	132.1	1610	20.7	23.1	8.00	8.12	45	57	553	610	318	417	2.8	2.7	9.0	10.9
SR05	129.9	1620	21.6	22.7	8.09	8.33	42	51	533	597	310	400	4.4	5.9	16.9	37.9
SR06	129.5	1620	21.9	21.5	8.11	8.22	42	51	535	598	317	408	2.8	3.7	8.8	14.1
SR07	127.7	1620	21.5	22.3	8.00	8.16	46	55	573	607	298	404	2.6	6.4	11.9	15.7
SR08.2	127.4	1620	21.9	20.6	7.99		46	64	578	634	322	397	2.4		16.0	13.5
SRJPMZ	127.0	1620	22.0	21.9	7.57	7.73	91	100	795	808	417	522	2.6	3.5	42.0	46.3
SR08	126.2	1630	21.5	21.1	7.84	8.08	66	82	711	844	407	572	2.7	5.3	22.0	27.5
SR09	125.3	1640	21.5	20.2	7.80	7.97	66	84	718	898	382	575	2.6	3.2	31.0	32.5
SR10	123.8	1670	21.4	20.2	7.83	8.08	69	83	794	887	443	578	2.4	2.9	32.9	26.2
SR11	120.1	1700	20.1	22.3	7.78	8.05	66	79	781	798	452	572	2.7	4.2	15.9	21.6
SRCSMZ	118.2	1710	20.4	20.4	7.47	8.00	98	78	912	896	530	560	1.7	3.1	40.5	64.4
SR12	118.0	1710	20.5	20.9	7.58	7.97	77	84	840	868	483	568	2.3	2.9	18.0	18.5
SR13	116.9	2260	20.0	20.4	7.68	7.95	67	84	761	786	437	513	2.4	2.4	18.3	20.6
SR14	116.0	2270	20.1	20.5	7.64	7.95	68	83	747	807	423	518	2.2	2.4	30.1	17.0
SR15	114.4	2280	19.7	20.5	7.72	7.97	69	85	724	802	420	522	2.3	2.4	17.7	23.1
SR16	109.3	2310	18.7	22.7	7.81	7.95	61	82	692	768	397	523	2.8	2.2	17.1	17.9
SR17	108.5	2320	19.5	19.0	7.77	7.93	60	79	702	789	405	528	2.4	2.5	14.2	17.5
SR18	105.1	2610	19.5	19.1	7.83	8.03	59	77	678	854	403	517	2.5	2.7	13.6	20.4
SR19	102.1	2640	20.4	22.9	7.85	8.07	58	78	690	773	400	517	2.3	3.0	13.0	15.6
SR20	99.9	3200	20.0	22.5	7.87	8.18	58	69	718	835	423	490	2.4	2.2	16.2	17.1
SR21	99.4	3220	18.9	19.7	7.28	8.12	60	71	735	817	425	510	2.4	2.7	15.4	14.1
SR22	98.7	3220	20.2	20.3	7.72	8.15	59	72	730	798	432	505	2.5	3.3	15.2	18.5
SR23	97.9	3220	20.4	19.1	7.76	8.13	59	71	730	814	430	510	2.4	3.8	14.5	21.9
BW06	9.6	547	20.6	18.7	7.82	7.95	61	60	643	626	368	372	1.8	2.8	5.9	8.4
Large River Narrative Threshold Rankings	<50th Percentile		<22.0		<7.9		<45.5		<735		<463.0		ND		<25	
	<75th Percentile		<24.0		<8.2		<57		<820		<499.5		<5		<40	
	<90th Percentile		<26.0		<8.3		<71		<900		<543.4		<15		<64.4	
	<95th Percentile		<27.0		<8.55		<77.3		<942		<580.4		<30		<90.2	
	>95th Percentile		>27.0		>8.55		>77.3		>942		>580.4		>30		>90.2	
Source			Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP	

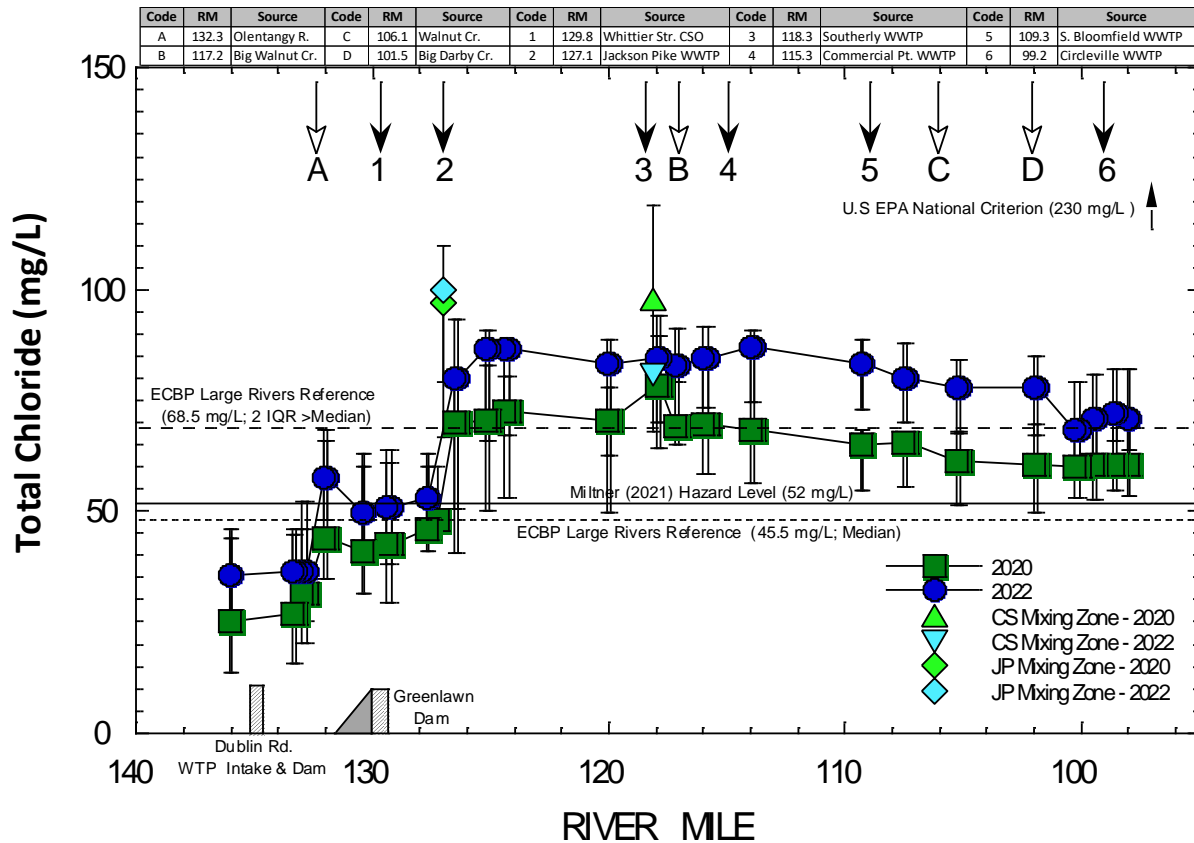


Figure 18. Median, maximum, and minimum total chloride (mg/L) in the middle Scioto River based on grab samples from the mainstem during June-October, 2020 and 2022. The Miltner (2021) hazard level is shown by a solid line and the Ohio ECBP ecoregion large river median and statistical maximum values are shown by dashed lines. Major tributaries (letters) and discharges (numbers) are indicated along the top of the graphic.

above the Miltner (2021) hazard level. The longitudinal pattern in 2020 and 2022 clearly showed the means to be consistently elevated in 2022 (Figure 18). The Maximum values trended closely to the median values and all exceeded the regional reference median threshold upstream from Jackson Pike. The highest mean and maximum values occurred in the Jackson Pike (RM 127.0, SRJPMZ) and Southerly (RM 118.1, SRCMZ) mixing zones reaching 100 mg/L or above. The overall trend clearly indicates Jackson Pike as a major source during summer-fall normal flows with Southerly sustaining elevated chloride levels downstream from that discharge.

Total Dissolved Solids

Total dissolved solids (TDS) is a measure of the dissolved content of all inorganic and organic substances present in water consisting of solids small enough to pass through 2-micron filter. While TDS is not generally considered to be a pollutant it can be useful as an aggregate indicator of the presence of a broad array of chemical pollutants. Common nonpoint sources of TDS in receiving waters are agricultural and urban runoff with parent geology and soils being important co-factors. Point sources of both industrial and municipal wastewater also influence

TDS levels. The most common chemical constituents are calcium, phosphates, nitrates, sodium, potassium, and chloride, each of which can emanate from the aforementioned nonpoint and point sources. Total dissolved solids are differentiated from total suspended solids (TSS), in that the latter cannot pass through a 2 micron filter and are indefinitely suspended in solution. The Ohio TDS water quality criterion is 1500 mg/L. Regional reference values for large rivers in the ECBP are a median of 463 mg/L and a statistical maximum of 536 mg/L.

2022 TDS Results

Similar to chlorides mean TDS values in 2022 were consistently higher than in 2020 increasingly eclipsing the regional reference thresholds beginning at Jackson Pike and remaining elevated throughout the mainstem (Table 14). In 2020 TDS also increased longitudinally in a manner similar to total chloride being just below or slightly above 300 mg/L upstream from the Jackson Pike WWTP (RM 127.1; Figure 19). Mean values increased downstream to just above the regional reference median of 463 mg/L and then declining to around 400 mg/L for the remainder of the middle mainstem. Only five sites had maximum values that were either slightly above or at the statistical maximum value of 536 mg/L. The downstream increases were, like chloride, related mostly to the Jackson Pike WWTP.

Specific Conductance

Specific Conductance is a measure of how effectively water conducts an electrical current. Conductance increases with an increasing amount and mobility of ions and is correlated with the dissolved solids content of water. The ions conduct electricity because they are negatively or positively charged when dissolved in water. As such conductance is an indirect measure of the concentration of dissolved ions in solution and is defined as the electrical conductance of 1 cubic centimeter (cm³) of a solution at 25°C. The Ohio WQS have a conductance criterion of 2400 µS/cm that is equivalent to the TDS criterion of 1500 mg/L. Regional reference conductance values for large rivers in the ECBP ecoregion are a median of 680 µS/cm and a statistical maximum of 776 µS/cm.

2022 Specific Conductance Results

Similar to chloride and TDS, mean and maximum specific conductance values were higher in 2022 than 2020, but this was not invariable with two sites having slightly higher values. However, they did not eclipse the upper percentile of regional reference values until the Jackson Pike mixing zone and all site downstream. The 2020 mean and maximum values were well below the median regional reference value of 680 µS/cm downstream to the Jackson Pike WWTP (RM 127.1). Values increased to above the regional reference median and then above the maximum downstream to the Southerly WWTP (RM 118.2; Figure 19). Median values declined downstream from Southerly to between the median and maximum reference values and remained in that range through the remainder of the study area. Maximum values exceeded the regional reference maximum at all sites downstream from both Jackson Pike and Southerly. The principal source of the elevated conductance levels relative to upstream and downstream is the Jackson Pike WWTP (RM 127.1).

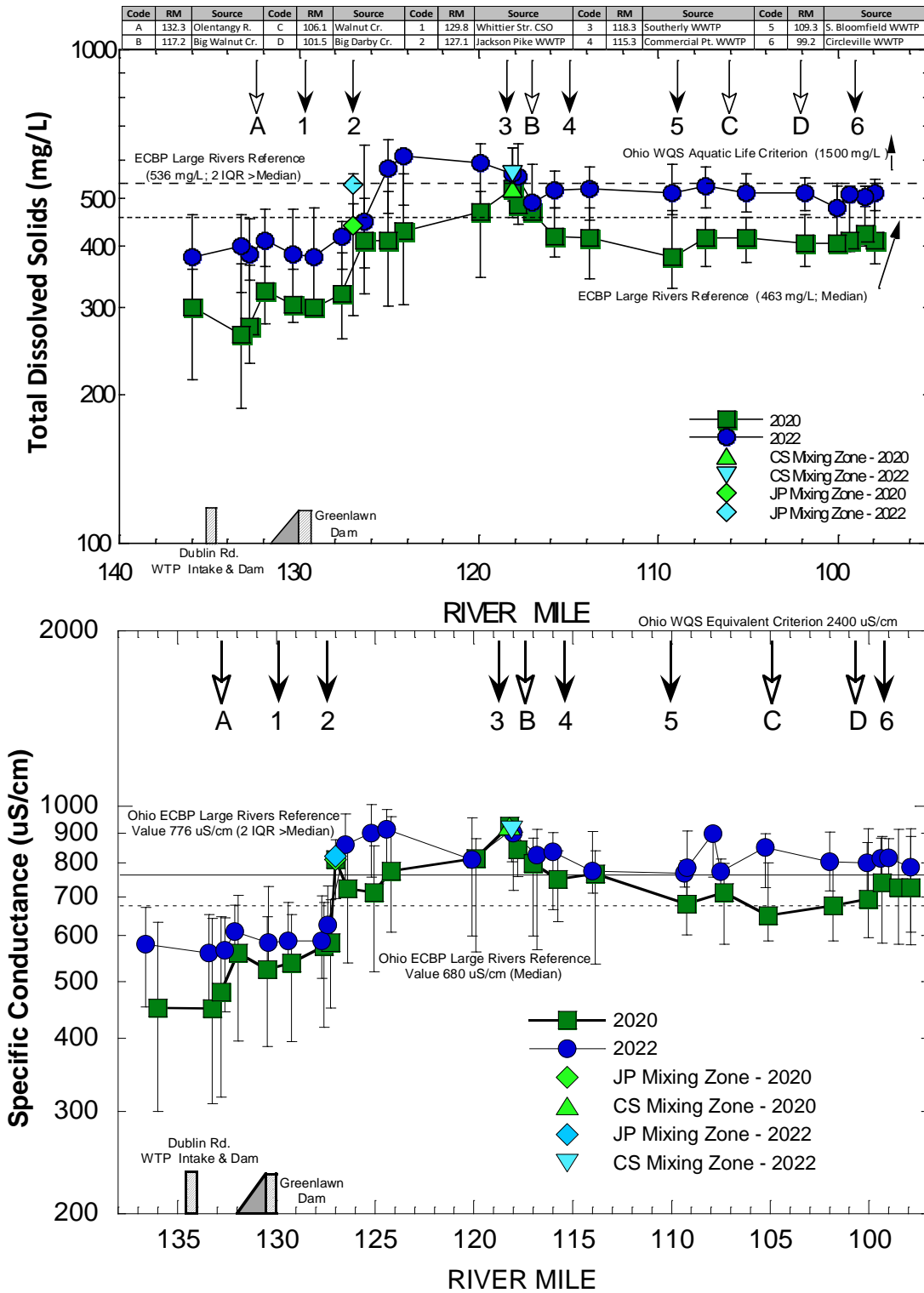


Figure 19. Median, maximum, and minimum total dissolved solids (mg/L; upper) and specific conductance ($\mu\text{S}/\text{Cm}$; lower) in the middle Scioto River based on grab samples from the mainstem during June-October, 2020 and 2022. The Ohio ECBP ecoregion large river median and statistical maximum values are shown by dashed and solid lines. Major tributaries (letters) and discharges (numbers) are indicated along the top of the graphic.

Total Suspended Solids (TSS)

Total suspended solids (TSS) are particles that are larger than 2 microns that occur in the water column. Anything that can pass through a 2 micron average filter size is considered a dissolved solid. TSS can include any particles drifting in the water column to include inorganic sediment, silt, and sand and organic matter such as plankton and algae. At typical ambient concentrations TSS has little or no direct effect on aquatic life. However, extremely high concentrations can be harmful to fish and invertebrate by clogging gills and smothering substrates. It is easy to measure and thus it is commonly employed as a singular indicator of nonpoint source pollution (MS4 stormwater permitting) despite its inherent variability and shortcomings as a reliable standalone indicator of impairment. Miltner (2018) included it as a large river nutrient effects parameter, but in a restricted role as a screening proxy parameter with >25 mg/L indicating enriched conditions when other indicators such as BOD₅ and TKN are not available.

2022 TSS Results

Mean TSS values in 2022 were remarkably similar ranging from 10-19 mg/L and with no apparent pattern related to any particular sources. This compares to the 2020 results that were more variable including high mean values of 48 mg/L at SR06 (RM 129.6) in the Greenlawn Impoundment and another similar mean of 47.3 mg/L at SR 18 (RM 105.1) downstream from Walnut Creek. These two sites also had the highest maximum values of 200 and 190 mg/L, respectively. The Greenlawn impoundment value occurred about one week following a spate of elevated flows and was likely due to excess sediment in the water column. The second most elevated maximum at SR18 occurred under low flows and after an extended period of some of the lowest flows of the year which suggests it was due to elevated algal production. This spike in TSS also corresponded to elevated mean and maximum BOD₅ at this same site suggesting a source of organic enrichment emanating from Walnut Creek. The remaining maximum values were at or well below the statistical maximum regional reference value for the ECBP ecoregion. None of the median values in 2020 or 2022 exceed the Miltner (2018) screening threshold of 25 mg/L. It is plausible to conclude that the mean values mostly knowing the flow conditions preceding a sample and the correspondence to other parameters is needed. Both the 2020 and 2022 mean values of 5-6 mg/L and 7-8 mg/L, respectively in the Jackson Pike and Southerly mixing zones were lower than those in the ambient mainstem and well below the TSS limitations of 16 mg/L as a monthly average and 24 mg/L as a weekly average (summer period) in their NPDES permits. An episodic event occurred downstream from the Shelley Materials discharge when a high loading of suspended solids was released upstream from site SR09 (RM 125.3). The first attempt at fish sampling had to be postponed because of an extensive turbidity plume that precluded electrofishing on August 18 (Figure 20). While TSS levels were not measured during this event they were obviously many times higher than ambient levels measured at this site during the summer-fall index period. Such episodes while seemingly serious are likely temporal in their long term effects provided the riverine habitat is sufficient to ameliorate the impacts.

Temperature and pH

The grab sample data for mean temperature and pH included in Table 14 revealed no



Figure 20. Turbidity plume caused by the release of excessive suspended solids from the Shelly materials quarry upstream from site SR09 (RM 125.3) on August 18, 2023.

exceedances of water quality criteria and only moderate exceedances of regional reference thresholds. Differences between 2020 and 2022 were well within normal variations with a mix of highest values occurring in both 2020 and 2022.

Mean pH levels were highest in the mainstem upstream from and including SR07 (RM 127.7) to SR01 (136.5) downstream from Griggs Dam. All but a few means exceeded 8.0 S.U. in both 2020 and 2022. This appears to be a moderate response to enrichment originating from Griggs Reservoir coupled with the altered hydrological characteristics of that reach. Mean pH values

declined somewhat downstream from Jackson Pike and were consistently higher in 2022.

Heavy Metals and Organic Compounds

Heavy metal and organic compounds in water are generally regarded as indicators of acute and chronic toxicity that were readily detectable at harmful amounts prior to the mandating of controls from point sources by the 1972 CWA and thereafter from other sources via other laws and regulations. Since the development of water quality based limitations in NPDES permit and general cleanup of other sources of metal and organic contaminants, measuring concentrations and even detecting metals and some organics in the water column has become rare to non-existent. Analyzing for metals and organic compounds in sediments has been emphasized more as these compounds have been at or below detection in the water column. Sediments can retain these compounds longer and represent a longer term measure of the true levels of contamination.

Water Column Metals

Heavy metals analyzed in grab water samples included arsenic (As), cadmium (Cd), copper (Cu), chromium (Cr), iron (Fe), nickel (Ni), lead (Pb), silver (Si) and zinc (Zn) in their total recoverable state (Table 15). Hardness was also calculated from the measured concentrations of magnesium (Mg) and calcium (Ca) to determine the hardness dependent water quality criteria for each heavy metal. Hardness levels in 2022 ranged from a low of 227 mg/L (SRJPMZ) to a high value of 328 mg/L at two locations upstream from the Southerly WWTP (SR10 and 11) and the mixing zone (SRCSMZ). The mean for the mainstem was 283 mg/L which was used to screen for criteria exceedances and was higher than the mean of 235 mg/L in 2020. None of the metal

Table 15. Mean values for water column heavy metals in the middle Scioto River mainstem in 2020 and 2022. Bold italic values are the highest between the two years. Values are color coded in accordance with the legend at the bottom.

Site ID	River Mile	Drainage Area (mi. ²)	Hardness mg/L		Arsenic ug/L		Cadmium ug/L		Chromium ug/L		Copper ug/L		Iron ug/L		Lead ug/L		Nickel ug/L		Silver ug/L		Zinc ug/L			
			2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022		
Scioto River																								
SR01	136.5	1050	170	237	2.50	2.40	0.15	0.04	--	0.90	3.80	2.77	440	169	0.63	0.29	4.50	4.78	--	0.03	7.30	27.22		
SR02	133.4	1050	160	233	2.40	2.35	0.03	0.05	--	1.04	2.40	3.38	360	181	0.44	0.32	3.90	4.80	--	0.04	5.70	9.53		
SR03	132.7	1070	160	235	2.40	2.38	0.03	0.05	--	1.10	2.60	2.93	430	179	0.67	0.36	4.00	4.78	--	0.03	6.20	18.35		
SR04	132.1	1610	220	247	2.40	2.18	0.05	0.04	--	1.34	2.80	2.70	390	280	0.90	0.55	4.40	4.72	--	0.03	9.00	10.93		
SR05	129.9	1620	210	240	2.30	2.27	0.10	0.04	--	1.28	4.80	5.90	1000	265	3.30	0.65	5.70	4.72	--	0.03	19.90	37.87		
SR06	129.5	1620	220	244	2.00	2.38	0.05	0.05	--	1.27	3.00	3.72	500	418	1.10	0.87	4.60	5.06	--	0.03	8.10	14.06		
SR07	127.7	1620	240	260	2.30	2.18	0.05	0.04	--	1.36	2.60	6.44	340	292	1.40	0.99	4.60	5.00	--	0.03	9.00	15.66		
SR08.2	127.4	1620	230	252	2.30	2.10	0.05	0.04	--	1.40	2.30	2.68	320	227	1.10	0.77	4.70	4.85	--	0.03	11.10	25.45		
SRJPMZ	127.0	1620	200	227	1.20	1.07	0.03	0.03	--	0.82	2.70	3.53	100	129	0.43	0.55	4.10	5.75	--	0.03	41.50	46.32		
SR08	126.2	1630	270	317	2.00	1.58	0.04	0.05	--	1.17	2.60	7.85	420	283	1.10	0.94	5.20	6.02	--	0.03	21.40	29.45		
SR09	125.3	1640	270	310	2.10	1.57	0.04	0.04	--	1.11	2.80	3.18	360	213	1.00	0.74	5.00	5.77	--	0.03	21.20	32.53		
SR10	123.8	1670	260	328	2.00	1.70	0.04	0.04	--	1.18	2.50	2.92	340	298	0.97	0.82	5.20	5.97	--	0.03	22.80	26.23		
SR11	120.1	1700	270	328	2.10	1.75	0.04	0.06	--	1.05	2.50	4.23	390	258	1.10	0.81	5.40	5.62	--	0.04	16.80	21.60		
SRCSMZ	118.2	1710	230	328	1.20	1.75	0.04	0.04	--	0.99	1.80	3.07	190	267	0.34	0.77	4.40	6.98	--	0.03	34.50	64.38		
SR12	118.0	1710	260	320	1.60	1.70	0.04	0.04	--	1.17	2.30	2.87	350	227	0.84	0.59	5.00	5.70	--	0.03	18.40	18.50		
SR13	116.9	2260	260	297	2.00	1.78	0.04	0.05	--	0.99	2.20	2.35	300	193	0.70	0.50	5.20	5.07	--	0.03	19.00	20.58		
SR14	116.0	2270	250	297	1.80	1.82	0.04	0.05	--	0.94	2.20	2.38	330	205	0.75	0.52	4.60	5.00	--	0.03	17.20	16.98		
SR15	114.4	2280	240	293	1.90	1.80	0.05	0.05	--	0.97	2.30	2.40	330	222	0.76	0.50	4.50	5.22	--	0.03	16.80	23.10		
SR16	109.3	2310	250	318	2.00	1.80	0.06	0.05	--	1.03	2.80	2.20	370	203	0.94	0.56	5.20	5.28	--	0.03	19.10	17.88		
SR17	108.5	2320	240	297	2.00	1.78	0.05	0.05	--	1.15	2.30	2.52	390	223	0.71	0.54	4.40	5.45	--	0.03	12.90	17.47		
SR18	105.1	2610	235	300	1.85	1.92	0.06	0.06	--	0.86	2.45	2.67	290	200	0.76	0.49	4.60	5.27	--	0.03	13.60	20.40		
SR19	102.1	2640	230	297	1.85	1.98	0.05	0.06	--	1.22	2.30	3.00	275	207	0.70	0.50	4.60	5.38	--	0.04	13.00	15.58		
SR20	99.9	3200	260	303	2.30	1.97	0.06	0.05	--	0.97	2.10	2.20	340	180	0.54	0.42	5.60	4.73	--	0.03	17.70	17.10		
SR21	99.4	3220	260	298	2.30	1.97	0.06	0.07	--	1.17	2.00	2.72	280	252	0.51	0.60	5.20	5.53	--	0.03	16.60	14.12		
SR22	98.7	3220	260	298	2.30	2.03	0.06	0.07	--	1.06	2.40	3.28	360	270	0.78	0.91	5.60	5.53	--	0.03	15.40	18.53		
SR23	97.9	3220	260	295	2.40	2.00	0.06	0.06	--	1.02	2.20	3.83	370	218	0.65	0.53	5.60	5.23	--	0.03	15.70	21.85		
BW06	9.6	547	270	240	1.75	2.20	0.05	0.05	--	0.92	1.80	2.77	250	243	0.29	0.37	4.25	3.95	--	0.03	5.85	8.38		
Ohio WQS for Aquatic Life			<OMZA ¹		<150		<4.8				<19.4		<1000		<19		<107				<246			
			≥OMZA ¹		≥150		≥4.8						≥19.4		≥1000		≥19		≥107				≥246	
			≥OMZM ¹		≥340		≥11.8										≥363		≥966				≥246	
			≥IMZA ¹		≥680		≥23.7										≥726		≥1931				≥494	

¹Ohio water quality criteria for aquatic life at a hardness of 235 mg/L; OMZA-Outside Mixing Zone Average; OMZM-Outside Mixing Zone Maximum; IMZM-Inside Mixing Zone Maximum

parameter results showed anything close to an exceedance of the chronic outside mixing zone maximum (OMZM) or average (OMZA) criteria at the average hardness measured in 2022. For some metals the measured levels were several orders of magnitude below the water quality criterion.

There were no distinct patterns that related to sources along the pollution continuum for arsenic, cadmium, chromium, copper, nickel, or silver with all values being remarkably similar at all 24 ambient and two mixing zone sites. For iron, a single value in the Greenlawn Dam impoundment of 1000 µg/L in 2020 equaled the water quality criterion, but all 2022 values and other 2020 sites had values that were 50% or less of this single mean value. In 2022 mean lead values were highest in the Jackson Pike WWTP and Southerly WWTP mixing zones, but lower than most 2020 values. Mean 2022 zinc levels showed a point source pattern with the highest values measured in the two mixing zones at ambient sites downstream from Jackson Pike, a similar result to 2020.

Sediment Metals

Metals in sediment were analyzed for the same seven parameters as in the water column (Table 16). The results were compared to Ohio EPA Sediment Reference Values (SRV; Ohio EPA 2008) and the Probable Effect Concentration (PEC) and Threshold Effect Concentration (TEC) of MacDonald et al. (2000). There were no exceedances of any PEC threshold in 2022 compared to a single exceedance for lead in 2020 downstream from the Dublin Rd. WTP dam and intake at RM 133.4 (SR02). Exceedances of the TEC and Ohio SRVs were scattered throughout the study area totaling 75 out of 200 samples with all metals were detected in all samples. The TEC exceedances were the most frequent for arsenic and nickel and sporadically so for lead, copper, and zinc. Exceedances of the SRVs were most common for copper, lead, and zinc. Compared to sediment results obtained by Ohio EPA at Frank Rd. (RM 127.7, SR07) in the Scioto River in 2010 and 1996 metals levels in sediment have declined since 1996 (Ohio EPA 2012). The highest degree of sediment metals levels in 2010 were recorded in Kian Run which enters the Scioto River just downstream from the Jackson Pike WWTP.

Sediment Organics

Organic chemicals in sediment were analyzed for polycyclic aromatic hydrocarbon (PAH) and semi-volatile organic compounds. Of the nine (9) semi-volatile organic compounds that were analyzed only four had detectable results in 2022 and five (5) in 2020 and none were at concentrations of any concern (Table 16). Most are common by products of various manufacturing processes and the likely source is urban runoff or legacy pollution. Three (3) of the nine (9) semi-volatile compounds were detected at two (2) or more sites in 2022. Using thresholds cited in Buchman (2008), there was only a single value for bis(2-Ethylhexyl)phthalate at RM 133.4 (SR02) downstream from the Dublin Rd. WTP dam and intake that exceeded the lowest risk level for that compound in 2020. In 2022 there were low risk exceedances of methylene chloride at five (5) locations all downstream from the Southerly WWTP, low risk exceedances of acetone at 11 sites scattered along the mainstem with the highest value downstream from the Southerly WWTP, and three low risk exceedances of benzoic acid. The

Table 16. Concentrations of selected heavy metals in bulk sediment samples collected at 25 ambient locations in the Scioto River mainstem in October 2022. The Ohio EPA sediment reference values (SRV) and MacDonald et al. (2000) threshold effect (TEC) and probable effect (PEC) thresholds are indicated at the bottom of the table.

Site ID	River Mile	Drainage Area (mi. ²)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Chromium (mg/kg)	Iron (mg/kg)	Nickel (mg/kg)	Lead (mg/kg)	Zinc (mg/kg)	Detects	Exceed-ances
<i>Scioto River</i>												
SR01	136.20	1050	4.8	0.20	6	6.5	8400	17	12	50	8	0
SR02	133.30	1050	9.2	0.42	17	14.1	12000	15	49	68	8	1
SR03	133.00	1070	11.0	0.49	19	15.2	17000	21	49	95	8	2
SR04	131.80	1610	14.0	0.90	36	17.1	26000	28	99	198	8	6
SR05	130.40	1620	12.0	0.72	36	21.5	21000	28	51	170	8	5
SR06	129.10	1620	18.0	1.10	45	28.1	28000	34	74	229	8	6
SR07	127.50	1620	9.1	0.38	22	17.6	16000	18	38	108	8	1
SR08.2	127.40	1620	12.0	0.65	56	18.7	20000	24	63	188	8	5
SR08	126.40	1630	8.8	0.68	32	19.0	21000	22	39	171	8	3
SR09	125.30	1640	28.0	0.85	50	33.3	45000	47	69	234	8	6
SR10	124.40	1670	9.1	0.65	26	15.9	17000	19	37	164	8	2
SR11	119.90	1700	7.8	0.42	27	16.7	18000	23	25	140	8	3
SR12	118.10	1710	8.2	0.33	90	11.6	14000	15	17	91	8	1
SR13	117.10	2260	14.0	0.84	28	12.8	19000	26	21	142	8	4
SR14	116.30	2270	11.0	0.82	26	16.4	24000	22	26	188	8	4
SR15	113.80	2280	9.4	1.90	31	35.0	17000	23	46	200	8	4
SR16	109.20	2310	16.0	2.20	46	42.3	27000	34	60	233	8	7
SR17	107.40	2320	11.0	0.44	18	12.8	18000	19	20	98	8	1
SR18	105.20	2610	12.0	0.54	97	13.1	20000	21	18	103	8	2
SR19	102.00	2640	13.0	0.76	26	14.8	20000	24	23	137	8	4
SR20	100.00	3200	11.0	0.43	17	12.2	16000	19	16	92	8	1
SR21	99.70	3220	15.0	0.56	29	17.4	26000	32	22	160	8	3
SR22	98.90	3220	18.0	0.74	24	14.1	22000	23	21	122	8	3
SR23	97.90	3220	9.5	0.36	14	10.3	14000	18	15	83	8	0
BW06	9.6	547	14.0	0.54	17	10.7	17000	20	17	120	8	1
Ohio EPA		SRV	25.1	0.8	33	40	51000	61	47	170		
MacDonald et al. (2000)		PEC	33.0	5	--	43.4	--	49	128	459		
		TEC	9.8	0.99	32	111	--	23	23	121		

Table 17. Concentrations of semi-volatile organic compounds in bulk sediment samples collected at 24 ambient locations in the Scioto River mainstem in October 2020 and 2022. ND values are below the MDL.

Site ID	River Mile	Drainage Area (sq. mi.)	Methylene Chloride (mg/kg)		bis(2-Ethylhexyl)phthalate (mg/kg)		4-Methylphenol (mg/kg)		Dibenzofuran (mg/kg)		Acetone (mg/kg)		Benzoic Acid (mg/kg)		Benzyl Alcohol (mg/kg)		Butyl Benzyl Phthalate (mg/kg)		Pyridine (mg/kg)		Number of Detections	
			2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022
Scioto River																						
SR01	136.5	1050	ND	2.850	ND	ND	ND	ND	0.033	ND	ND	7.000	ND	3.100	ND	ND	ND	ND	ND	ND	1	3
SR02	133.4	1050	0.580	ND	0.710	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2	0	
SR03	132.7	1070	ND	ND	ND	ND	ND	ND	ND	ND	ND	20.000	ND	ND	ND	ND	ND	ND	ND	0	1	
SR04	132.1	1610	ND	ND	0.078	ND	0.046	ND	0.045	ND	ND	ND	0.085	ND	ND	ND	ND	ND	ND	4	0	
SR05	129.9	1620	0.390	ND	0.031	ND	ND	ND	ND	ND	ND	14.000	0.049	3.400	ND	ND	ND	ND	ND	3	2	
SR06	129.5	1620	ND	ND	ND	ND	ND	ND	0.058	ND	ND	8.400	0.110	ND	ND	ND	ND	ND	ND	2	1	
SR07	127.7	1620	ND	ND	0.043	ND	ND	ND	0.029	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2	0	
SR08.2	127.4	1620	ND	ND	ND	ND	0.080	ND	0.047	ND	ND	8.400	0.060	ND	ND	ND	ND	ND	ND	3	1	
SR08	126.2	1630	ND	ND	ND	ND	ND	ND	0.034	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	0	
SR09	125.3	1640	ND	ND	ND	ND	ND	ND	0.024	ND	ND	ND	0.066	ND	ND	ND	ND	ND	ND	2	0	
SR10	123.8	1670	ND	ND	ND	ND	ND	ND	ND	ND	ND	11.000	ND	ND	ND	ND	ND	ND	ND	0	1	
SR11	120.1	1700	ND	ND	ND	ND	ND	ND	ND	ND	ND	16.000	ND	ND	ND	ND	ND	ND	ND	0	1	
SR12	118.0	1710	ND	3.600	ND	ND	ND	ND	ND	ND	ND	33.000	0.085	ND	ND	ND	ND	ND	ND	1	2	
SR13	116.9	2260	ND	2.100	ND	ND	ND	ND	ND	ND	ND	17.000	0.083	ND	ND	ND	ND	ND	ND	1	2	
SR14	116.0	2270	ND	2.100	ND	ND	ND	ND	0.050	ND	ND	7.600	0.065	ND	ND	ND	ND	ND	ND	2	2	
SR15	114.4	2280	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	0	
SR16	109.3	2310	ND	ND	0.049	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	0	
SR17	108.5	2320	ND	3.400	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.800	ND	ND	ND	ND	ND	0	2	
SR18	105.1	2610	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	0	
SR19	102.1	2640	ND	2.600	ND	ND	ND	ND	ND	ND	ND	9.600	ND	ND	ND	ND	ND	ND	ND	0	2	
SR20	99.9	3200	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	0	
SR21	99.4	3220	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	0	
SR22	98.7	3220	ND	ND	ND	ND	0.032	ND	ND	ND	ND	7.400	ND	ND	ND	ND	ND	ND	ND	1	1	
SR23	97.9	3220	ND	ND	ND	ND	ND	ND	0.034	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	0	
Thresholds	Low Risk		2.00 ^d		0.18 ^c		0.67 ^e		0.415 ^e		0.04 ^e		0.65 ^e				0.10 ^b		0.10 ^b		27.00	21.00
	High Risk								5.1 ^a										0.50 ^b			
References	^a NOAA SQUIRT Guidelines <i>Hyalella azteca</i> bioassay threshold ("lowest reliable target").																					
	^b NOAA SQUIRT Guidelines: Dutch Sediment Serious Contamination Levels "Target vs. Intervention".																					
	^c EPA Region III BTAG, Freshwater Sediment Screening Benchmarks (Risk "Comparison Values 2006).																					
	^d Ecological Screening Values for Surface Water, Sediment, and Soil by G. P. Friday (WSRC-TR-98-00110); value represents the intervention value (MHSPE 1994) divided by a factor of 10.																					
^e U.S. EPA (2015) Region 4 Ecological Risk Assessment Supplemental Guidance.																						

total number of detections were 27 in 2020 with a single low risk exceedance and 21 in 2022 with 20 low risk exceedances. The number of detections was consistently highest (2-4 detections) in the reach between the Olentangy River (RM 132.3) downstream to the site upstream from the Jackson Pike WWTP (RM 127.2) which is also directly impacted by urban runoff. Scattered (1-2) detections occurred at a lower rate downstream from both WWTPs and at the two downstream most sites, RM 98.7 (SR22) and 98.9 (SR23), which are both downstream from the Circleville WWTP (RM 99.2).

Dibenzofuran was not detected at any 2022 site, but was detected at concentrations well below the low risk level in 2020, the detections occurred the most consistently of any other semi-

volatile compound downstream from the Greenlawn Dam at RM 129.5 (SR06) downstream to RM 125.3 (SR09) which is affected by urban runoff including areas with an industrial legacy. This compound emanates from coal tar which is most commonly associated with urban land uses and industrial sources. Detections also occurred downstream from Griggs Reservoir at RM 136.5 (SR01), downstream from the Olentangy River at RM 132.1 (SR04), at RM 116.0 (SR14), and the downstream most site at RM 97.9 (SR23). The last two sites are in proximity to legacy sources of coal tars, the former Picway EGS at RM 116.3 (SR14) and the former Jefferson Smurfitt paper mill at RM 99.4 (SR23).

Polycyclic Aromatic Hydrocarbon (PAH) compounds are more commonly detected in sediment samples especially in urban areas. All of the detected PAH compounds are by products of coal tar, gasoline exhaust, are products of incomplete combustion, and several are known carcinogens. Most of these compounds are not manufactured and are more commonly detected in urban rivers and streams with runoff from asphalt pavement and heavy automobile traffic as the primary sources. Out of 408 sample analyses for 17 PAH compounds 307 were detections in 2020, but only 145 were detections in 2022. However, the exceedances of a TEC/LEL or PEC/SEL threshold was 143 in 2020 and 144 in 2022. Of the 12 PAH compounds that were detected in the mainstem in 2022, only one (1) was detected at every site (Table 19). The majority of exceedances of TEC/LEL thresholds occurred upstream from I-270S (46) with less frequent exceedances downstream. For PEC/SEL exceedances the clear majority occurred upstream from I-270S with 16 occurring downstream, 10 at the next two sites downstream and none below SR16 at St. Rt. 316 near South Bloomfield. None of the 2020 results exceeded any of the MacDonald et al. (2000) PEC or Persaud et al. (1993) severe (SEL) effect thresholds that exist for 15 of the 17 compounds or for total PAH concentrations. Exceedances of the low effect (LEL) thresholds were common for some PAH compounds. The total PAH LEL threshold of Persaud et al. (1993) was exceeded at 10 sites in 2020 and 16 in 2022. Total PAH concentrations were the highest between SR03 (RM 132,7) and SR11 (RM 120.1). Locally occurring downstream from location of the former Picway EGS (RM 116.3) and the lowermost site (RM 97.9, SR23) which is downstream from the former CCA paper mill in Circleville. All 17 PAH compounds were detected at two sites in 2020 between SR01 (RM 136.5) downstream from Griggs Reservoir and RM 132.1 (SR04) downstream from the Olentangy River confluence, but that was drastically reduced in 2022 with only six (6) and four (4) detects, respectively. Compared to other urban/industrialized areas in Ohio and the Midwest the levels of organic chemicals in sediment were comparatively low.

Physical Habitat for Aquatic Life

The physical habitat of a stream or river is a primary determinant of biological quality and potential. Rivers and streams in the glaciated Midwest, left in their natural state, typically offer pool-run-riffle sequences, moderate to high sinuosity, and well-developed channels with deep pools, heterogeneous substrates, and cover in the form of woody debris, hard substrates, and aquatic macrophytes. The Qualitative Habitat Evaluation Index (QHEI) categorically scores basic components of stream and riverine habitat into ranks according to the degree to which those components are found compared to a natural state, or conversely, in an altered or modified

Table 18. Concentrations of polycyclic aromatic hydrocarbon (PAH) compounds in bulk sediment samples collected at 24 ambient locations in the Scioto River mainstem in October 2020 and 2022 with exceedances of Low and Threshold Effect (LEL, TEC) and Severe and Probable Effect (SEL, PEC) color coded. ND values were below the MDL.

Site ID	River Mile	Drainage Area (sq. mi.)	Anthracene (mg/kg)		Acenaphthene (mg/kg)		Carbazole (mg/kg)		Dibenzo(a,h)anthracene (mg/kg)		Benzo(ghi)perylene (mg/kg)		Indeno(1,2,3-c,d)pyrene (mg/kg)		Phenanthrene (mg/kg)		Benzo(a)Anthracene (mg/kg)		Benzo(k)fluoranthene (mg/kg)		Benzo(a)pyrene (mg/kg)		Chrysene (mg/kg)		Benzo(b)fluoranthene (mg/kg)		Pyrene (mg/kg)		Fluoranthene (mg/kg)		Fluorene (mg/kg)		Naphthalene (mg/kg)		2-Methylnaphthalene (mg/kg)		Total PAH		Total PAH Detections		Total PAH Exceedances			
			2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022				
Scioto River																																												
SR01	136.5	1050	0.082	ND	0.036	ND	0.120	ND	0.160	ND	0.420	ND	0.490	ND	0.630	0.860	0.730	ND	0.760	ND	0.740	ND	1.000	0.635	1.200	ND	1.300	0.995	1.400	1.300	0.040	ND	0.032	ND	0.039	ND	9.179	3.790	17	6	12	6		
SR02	133.4	1050	0.022	ND	ND	ND	ND	0.024	ND	0.047	ND	0.056	ND	0.110	1.400	0.110	ND	0.100	ND	0.100	ND	0.120	0.960	0.110	ND	0.200	1.800	0.230	2.200	ND	ND	ND	ND	ND	ND	1.229	6.360	12	4	3	4			
SR03	132.7	1070	ND	ND	ND	ND	ND	ND	ND	0.033	ND	0.036	1.800	0.067	2.900	0.062	2.200	0.072	1.300	0.063	2.500	0.077	3.000	0.075	1.800	0.130	4.900	0.160	6.300	ND	ND	ND	ND	ND	0.775	26.70	10	9	0	9				
SR04	132.1	1610	0.120	2.800	0.063	ND	0.120	ND	0.071	ND	0.120	1.300	0.160	3.400	0.640	14.00	0.650	6.600	0.650	4.000	0.630	6.900	0.770	8.100	0.870	4.700	1.000	16.00	1.200	21.00	0.064	1.200	0.040	ND	0.029	ND	7.197	90.00	17	12	11	12		
SR05	129.9	1620	0.027	0.490	ND	ND	0.032	ND	0.028	ND	0.054	2.400	0.072	1.900	0.170	3.800	0.220	2.900	0.240	2.200	0.220	3.600	0.260	4.400	0.310	2.900	0.430	7.200	0.460	9.500	0.016	ND	ND	ND	ND	ND	2.539	41.29	14	11	7	14		
SR06	129.5	1620	0.180	1.100	0.077	ND	0.096	ND	0.054	ND	0.094	1.200	0.130	2.200	0.660	6.200	0.540	4.600	0.510	3.000	0.520	5.200	0.570	6.200	0.680	3.700	0.830	10.000	0.990	14.000	0.092	ND	0.039	ND	0.025	ND	6.087	57.40	15	11	15	11		
SR07	127.7	1620	0.110	0.670	0.046	ND	0.070	ND	0.028	ND	0.050	1.400	0.065	2.200	0.600	4.500	0.400	2.800	0.510	1.800	0.400	2.600	0.460	3.700	0.530	2.100	0.780	5.900	1.100	8.600	0.055	ND	ND	ND	ND	ND	5.204	36.27	15	11	10	11		
SR08.2	127.4	1620	0.220	0.670	0.082	ND	0.140	ND	0.076	ND	0.130	2.000	0.180	2.600	0.940	4.500	0.710	3.400	0.690	1.900	0.700	3.400	0.800	4.500	0.890	2.200	1.300	7.800	1.400	9.200	0.085	ND	0.036	ND	ND	ND	8.379	42.17	16	11	12	11		
SR08	126.2	1630	0.130	ND	0.052	ND	0.077	ND	0.042	ND	0.066	2.200	0.091	1.200	0.580	1.900	0.410	1.100	0.350	0.690	0.360	1.400	0.430	1.800	0.390	1.100	0.770	2.700	0.910	3.900	0.057	ND	ND	ND	ND	ND	4.715	17.99	15	10	10	10		
SR09	125.3	1640	0.170	ND	0.047	ND	0.089	ND	0.025	ND	0.046	ND	0.059	ND	0.580	1.900	0.440	1.400	0.490	0.910	0.380	1.700	0.460	1.900	0.490	1.100	0.880	3.000	0.970	4.200	0.050	ND	ND	ND	ND	ND	5.176	16.11	15	8	10	8		
SR10	123.8	1670	ND	ND	ND	ND	0.028	ND	ND	ND	0.021	ND	0.021	ND	0.096	1.800	0.074	1.300	0.090	0.900	0.072	1.500	0.090	1.900	0.099	1.200	0.150	3.000	0.200	4.000	ND	ND	ND	ND	ND	ND	0.941	15.60	11	8	0	8		
SR11	120.1	1700	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.080	1.400	0.074	1.100	0.090	0.710	0.063	1.400	0.092	1.600	0.086	1.000	0.160	2.500	0.190	3.100	ND	ND	ND	ND	ND	ND	0.835	12.81	8	8	0	8		
SR12	118.0	1710	0.069	ND	ND	ND	0.030	ND	ND	ND	0.033	ND	0.039	ND	0.290	ND	0.220	ND	0.240	ND	0.210	ND	0.240	ND	0.250	ND	0.430	ND	0.590	ND	ND	ND	ND	ND	ND	ND	2.641	0.000	12	0	5	0		
Big Walnut Creek																																												
BW06	9.6	540																																										
SR13	116.9	2260	0.027	ND	ND	ND	0.025	ND	ND	ND	0.039	ND	0.044	ND	0.160	1.100	0.150	ND	0.200	ND	0.160	0.920	0.200	1.300	0.270	0.900	0.340	1.700	0.420	2.300	ND	ND	ND	ND	ND	ND	2.035	8.220	12	6	4	6		
SR14	116.0	2270	0.120	ND	ND	ND	0.042	ND	ND	ND	0.052	ND	0.070	ND	0.500	0.740	0.360	ND	0.430	ND	0.340	0.930	0.400	0.850	0.430	ND	0.750	1.100	0.900	1.600	0.044	ND	0.061	ND	0.092	ND	4.591	5.220	15	8	5	5		
SR15	114.4	2280	0.150	ND	ND	ND	0.064	ND	ND	ND	0.054	ND	0.056	ND	0.570	1.000	0.380	ND	0.350	ND	0.300	ND	0.440	0.870	0.330	ND	0.760	1.200	0.870	1.800	0.051	ND	ND	ND	ND	ND	4.375	4.870	13	4	8	4		
SR16	109.3	2310	ND	ND	ND	ND	0.028	ND	0.049	ND	0.130	ND	0.130	ND	0.170	1.200	0.250	ND	0.220	ND	0.130	0.260	ND	0.310	1.000	0.300	0.730	0.380	1.600	0.480	2.300	ND	ND	ND	ND	ND	ND	2.707	6.830	12	5	6	5	
SR17	108.5	2320	ND	ND	ND	ND	0.028	ND	0.038	ND	0.085	ND	ND	ND	0.180	0.780	0.250	ND	0.220	ND	0.240	ND	0.310	ND	0.280	ND	0.390	0.600	0.480	ND	ND	ND	ND	ND	ND	ND	2.501	1.380	11	2	6	1		
SR18	105.1	2610	ND	ND	ND	ND	0.028	ND	0.028	ND	0.060	ND	0.084	ND	0.160	ND	0.190	ND	0.200	ND	0.230	ND	0.240	ND	0.270	ND	0.340	ND	0.430	ND	ND	ND	ND	ND	ND	ND	2.260	0.000	12	0	5	0		
SR19	102.1	2640	ND	ND	ND	ND	ND	ND	ND	ND	0.036	ND	0.050	ND	0.078	0.880	0.095	ND	0.110	ND	0.100	ND	0.130	0.600	0.120	ND	0.180	1.000	0.230	1.600	ND	ND	ND	ND	ND	ND	1.129	4.080	10	4	0	4		
SR20	99.9	3200	ND	ND	ND	ND	ND	ND	ND	ND	0.036	ND	0.047	ND	0.089	0.780	0.110	ND	0.110	ND	0.120	ND	0.140	0.560	0.150	ND	0.180	0.710	0.270	1.100	ND	ND	ND	ND	ND	ND	1.252	3.150	10	4	1	4		
SR21	99.4	3220	ND	ND	ND	ND	ND	ND	ND	ND	0.037	ND	0.047	ND	0.110	ND	0.130	ND	0.140	ND	0.140	ND	0.160	ND	0.160	ND	0.220	ND	0.300	ND	ND	ND	ND	ND	ND	ND	1.444	0.000	10	0	2	0		
SR22	98.7	3220	ND	ND	ND	ND	ND	ND	ND	ND	0.040	ND	0.096	ND	0.150	ND	0.150	ND	0.160	ND	0.160	ND	0.200	0.760	0.190	ND	0.260	0.970	0.370	1.500	ND	ND	ND	ND	ND	ND	1.776	3.230	10	3	3	3		
SR23	97.9	3220	0.130	ND	0.033	ND	0.065	ND	0.036	ND	0.066	ND	0.092	ND	0.480	ND	0.350	ND	0.340	ND	0.330	ND	0.410	ND	0.380	ND	0.650	ND	0.870	ND	0.061	ND	ND	ND	ND	ND	4.293	0.000	15	0	8	0		
MacDonald et al. (2000) Thresholds	PEC		>0.845												>1.170		>1.050						>1.29				>1.520		>2.230		>0.536													
	TEC		>0.057												>0.204		>0.108						>0.166				>0.195		>0.423		>0.077													
	SEL		>370												>130		>320		>320				>950		>1480		>1340		>1440		>460		>1340		>850		>1020		>160			>10,000		
	LEL		>0.220													>0.060		>0.170		>0.200				>0.560		>0.320		>0.240		>0.370		>0.340		>0.240		>0.490		>0.750		>0.190			>4.000	

state. In the middle Scioto River study area, QHEI scores and physical habitat attributes were recorded in conjunction with the fish sampling conducted at each site. QHEI scores >60 are generally regarded as having the potential to support attainment of the WWH aquatic life use designation and scores >75 indicate excellent habitat. Conversely scores less than 60 have limited potential to support WWH and scores less than 45 indicate an inability to attain WWH, thus interventions to improve the QHEI would be needed. Rankin (1989, 1995) developed a matrix of QHEI attributes that include good attributes that enhance physical habitat and modified attributes that deter attainment of WWH. Generally ratios of modified to good attributes of >2.0 indicate that altered habitat is a deterrent to attaining WWH. In large rivers such as the Scioto, impoundment by low head dams and encroachment by treeless levees are the principal sources of significant habitat modification that can preclude WWH attainment. Outright channel modification is rare, but remnants do exist especially in the reach between Greenlawn Dam to Jackson Pike. The Greenlawn Dam (RM 129.8) is the only remaining impassable low head dam on the Scioto River mainstem between Dublin Rd. WTP dam and the mouth. It forms an impoundment that extends approximately 1.9 miles upstream from the dam. The dam at Main Street located about 1.6 miles upstream from the Greenlawn Dam impounded approximately 1.5 miles of the mainstem, but it was removed in 2014. The mainstem from Fifth Ave. (RM 136.5) downstream to I-270 South is almost continuously bordered by earthen levees some of which are adjacent to both abandoned and active gravel quarries. Rip rap is installed locally to keep these levees protected from erosion during elevated flows. With the exception of the remaining impoundment formed by Greenlawn Dam the river is essentially free-flowing with well-developed and locally recovering riverine habitat.

2022 QHEI Results

Habitat as measured by the QHEI in 2022 was good (≥ 60) or excellent (≥ 75) at all except one site (Figure 21). A fair (≥ 45 , < 60) QHEI of 57.0 was recorded in the Greenlawn Dam impoundment (RM 130.45, SR05) and was the lowest QHEI score in 2022 the same as in 2020. All except six (6) sites were excellent throughout the mainstem with good sites interspersed at various intervals. Similar to 2020, excellent scores prevailed downstream from Big Walnut Creek through the remainder of the mainstem with exception of a good score at RM 98.5 (SR22) that is partly affected by the brief impoundment caused by the remnants of a wicket dam that formerly diverted water into the Ohio-Erie canal. This dam is passable even under low river flows and is slated for removal.

2022 Habitat Attributes

A QHEI matrix showing both good and poor habitat attributes (after Rankin 1995) was developed for each site in the middle Scioto River mainstem study area (Table 19). The matrix includes an accounting of the number good and modified habitat attributes (Rankin 1989, 1995) and their ratio. Modified attributes are subdivided between high and moderate influence as defined by Rankin (1989) based on an analysis of the Ohio statewide database. The very low ratio of modified:good attributes confirms the exceptional to good quality of all except a few mainstem sites. The Greenlawn Dam impoundment had a modified:good ratio of 2.67 which is a reflection of the extensive impoundment of riverine habitat by the Greenlawn Dam. Indications

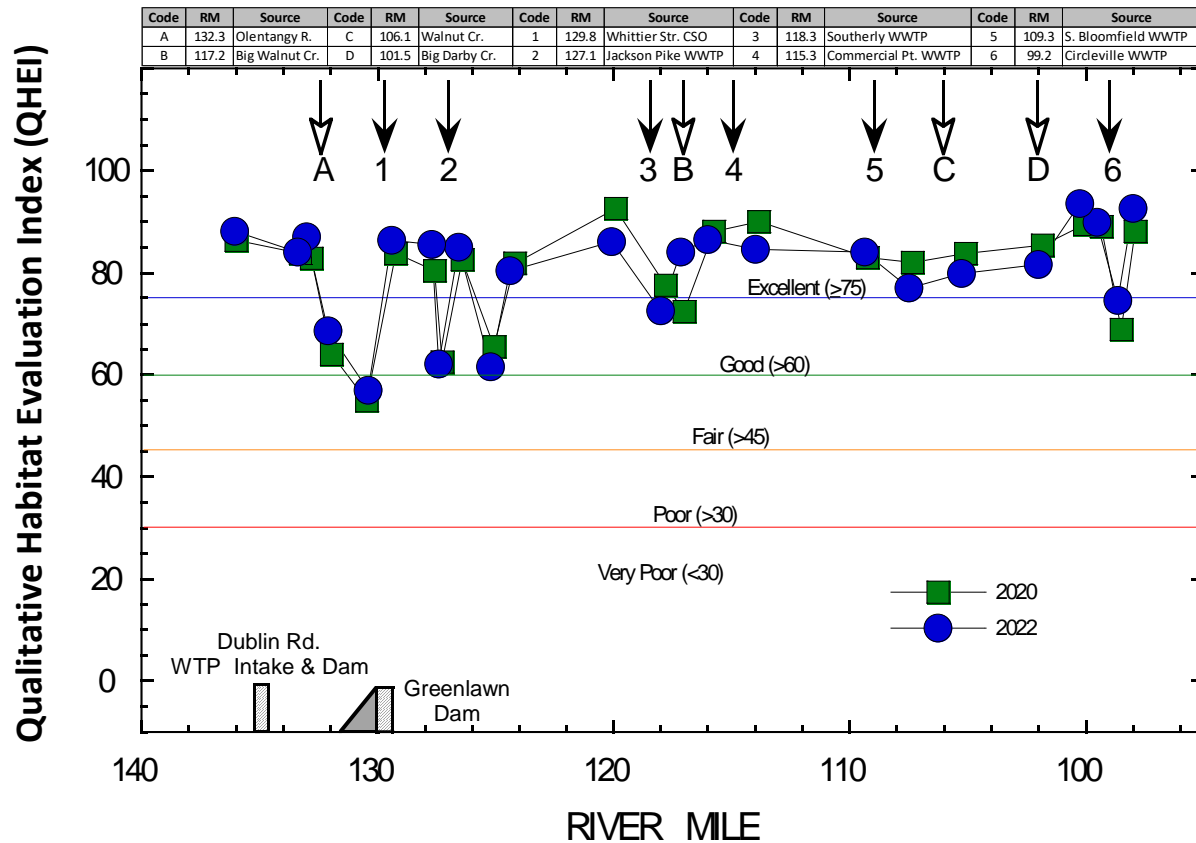


Figure 21. QHEI scores at sites sampled in the Scioto River mainstem in 2020 and 2022. Major tributaries (letters) and discharges (numbers) are indicated along the top of the graphic.

of habitat alteration in the upper reaches of the study area relative to the excellent characteristics of the mainstem included a ratio of 1.20 at SR01 (RM 132.10) downstream from the Olentangy River which reflects an incomplete recovery from the former Main Street dam impoundment seven years after its removal. This site had nearly as many poor habitat attributes (6) as did the Greenlawn Impoundment (7), but it had more good attributes reflecting the first stages of recovery. This is consistent with the above descriptions of one impoundment, treeless levees, and legacy channel modification that persist in the upper study area. Sites SR08.2 (RM 127.4) upstream from Jackson Pike and SR09 (RM 125.2) each had seven (7) poor attributes that were offset by five (5) good attributes resulting in lower, but good QHEI scores a result similar to 2020. Each was an outlier in terms of consistently better habitat at adjacent sites upstream and downstream with many fewer poor attributes and more good attributes. Sites in the mainstem downstream from I-270 included good or exceptional numbers of good attributes at all sites.

The site with the highest modified:good ratio and highest number of modified attributes was located just upstream from the Jackson Pike WWTP and downstream from the OARS bypass outfall structure at RM 127.25 (SR08.2). This site is bordered by a levee along the WWTP property and is in a reach of formerly channelized habitat. Generally, ratios greater than 2.00 mean that WWH is likely not attainable without direct intervention to reverse enough of the

modified attributes and restore good attributes. However, the accumulation of an elevated number of modified habitat attributes against a low number of good attributes (3) is localized to this site that is bordered by sites with good to excellent habitat upstream and downstream. Habitat has a reach scale influence (Rankin 1995) which in this case is a single modified site amongst mostly excellent to good sites.

Three other sites had elevated modified:good ratios relative to the majority of mainstem sites. The site at RM 125.05 (SR09) adjacent to the American Aggregates property had a good overall QHEI score, but a ratio of 1.75. Here again this was due to a low number of good attributes and an accumulation of modified attributes in a localized reach of river that is hemmed in by levees and gravel pits. Adjacent sites had excellent or good habitat scores and attribute ratios. The second site at RM 98.5 (SR22) had a ratio of 0.67 with 4 modified attributes and 6 good attributes, a slightly better result than in 2020. A portion of the site is influenced by pooled habitat that is formed by the remnants of the Ohio and Erie Canal Dam at Canal Park in Circleville. While not a true impoundment because the dam is passable, the habitat is nonetheless altered enough to preclude excellent characteristics that are commonplace in the lower study area. The third site (RM 131.95, SR04) with a comparatively elevated ratio of 1.20 (1.00 in 2020) is located in the reach of the mainstem that was formerly impounded by the Main Street Dam that was removed in 2014. While this reach is in recovery, the low number of good attributes reflect the almost indelible effect that dams and their impoundment can have on natural riverine habitat. This site had 5 good and 6 modified attributes, only one more good and one less modified attribute than the Greenlawn Dam impoundment. The expectation is for this site to improve, but with some limitations imposed by the adjacent levees and restrictions on channel movement and development.

Biological Assemblages – Fish

The fish assemblages of the Scioto River mainstem between the upstream site downstream from Fifth Avenue to Circleville have been consistently assessed in 30 of the past 43 years based on a systematic collection of data between 1979 and 2022. The data has been periodically reported by Ohio EPA in Yoder et al. (1981) and at least three subsequent biological and water quality reports (Ohio EPA 1986, 1999b, 2012). The latest most complete analysis includes all 23 years of fish assemblage data collected through 2015 in Yoder et al. (2019). This analysis focuses on the 2022 results and how it compares to 2020. A comprehensive analysis of trends in assemblage indices and attributes was accomplished in the 2020 report (MBI 2022). Summarized data tables for 2020, all years 1979-2020 for data collected by Ohio EPA and MBI, and for all years 1960-2020 that includes OSU Museum of Biodiversity (OSUMB) data are included in that report.

2022 Fish Assemblage Results

Because of the strong influence that the Greenlawn Dam (RM 129.8) has on fish assemblage composition in the middle Scioto River mainstem (especially upstream) the fish assemblage composition results are presented in terms of numbers and biomass upstream and downstream

from the dam. The lower four miles of the Olentangy River was also included in the upstream from Greenlawn reach for this analysis because of its connection to the Scioto River mainstem.

A total of 71 native species, 2 non-native species, and 5 hybrids were collected from the Scioto River mainstem downstream from Greenlawn Dam to Circleville in 2022 (Appendix Table B-3). Upstream from Greenlawn Dam to Griggs Dam and including the lower Olentangy upstream to Dodridge Dam, 44 native species, 1 non-native species, and 4 hybrids were collected in 2022 (Appendix Table B-4). One new species to the Ohio EPA and MBI surveys in 2022 that was collected by Brian Zimmerman of the OSU Stream and River Ecology (STRIVE) Lab is the Silver Carp (*Hypophthalmichthys molitrix*) of which a single individual was collected at a coincidental site downstream from Big Walnut Creek during the same date as one of the MBI fish sampling passes nearby. It is an exotic species of intercontinental origin native to eastern Asia and it has become established in several U.S. rivers via releases from fish culturing operations in Arkansas. This is the first record of this invasive species in the Middle Scioto River. The other two non-native species collected in 2020 are Common Carp and Grass Carp, the former being naturalized for more than one century and the latter presumably sterile escapees from ponds.

Fish Assemblage Response Indicators

Key fish assemblage response indicators were examined along the length of the 2022 mainstem and including the two fish assemblage indices, IBI and MIwb, included the number of native species, %DELT anomalies, the number of sensitive species, the proportion of fish as simple lithophils, and the proportion of fish as highly tolerant species (Table 20). These cover the breadth of assemblage response to chemical, physical, and biological stressors and are based on narrative ranges and thresholds described in Yoder and Rankin (1995b) and Yoder and DeShon (2003). With the exception of a fair IBI score in the Greenlawn Dam impoundment that met the MWH IBI biocriterion, and two non-attaining IBI scores at SR08.2 and SR09 that resulted in partial attainment of WWH, %DELTs, the number of sensitive species, and %simple lithophils exhibited a fair, poor, or very poor response at multiple sites. Only one site, SR05 (RM 130.45) in the Greenlawn Dam impoundment, had a poor response (%simple lithophils), and was the only site with more than two fair responses in 2020 and 2022. Five sites had two fair or lower responses in 2022 with SR01 (RM 136.005) exhibiting a poor response for %DELTs. Only four sites downstream from Big Walnut Creek had single fair responses with fair %DELTs at the first two sites downstream from Columbus Southerly (SR12 and SR13) and SR18 downstream from Walnut Creek. A fair result for sensitive species occurred at SR22 downstream from the Circleville WWTP. All of these response were good in 2020. However, the vast majority of the results were exceptional in 2022.

Fish Assemblage Indices – IBI and MIwb

The two principal fish indices in Ohio are the Index of Biotic Integrity (IBI; Ohio EPA 1987) and the Modified Index of Well-Being (MIwb; Ohio EPA 1987) each with biological criteria codified in the Ohio WQS (OAC 3745-1-07[C], Table 7-1). Their development and usage are detailed in Ohio EPA (1987) and Yoder and Smith (1999) with the biological criteria derivation in Ohio EPA (1987, 1989) in Yoder and Rankin (1995a) and their application Yoder (1995) and Yoder and Rankin

Table 20. Fish assemblage response indicators in the Scioto River mainstem between Fifth Ave. and Circleville in 2020 and 2022. The results for each indicator are color coded in accordance with the key at the bottom of the table including off shading for non-significant departures for the IBI and MIwb.

Site ID	River Mile	Drainage Area (mi. ²)	Fish Assemblage Response Indicators													
			IBI		MIwb		Native Species		%DELTA Anomalies		Sensitive Fish Species		%Simple Lithophils		%Tolerant Fish	
			2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022
SR01	136.00	1050	51	46	9.4	9.6	26.0	20.0	0.00	3.12	14.0	9.0	21.8	35.5	16.7	12.9
SR02	133.40	1070	46	44	9.3	9.6	22.0	22.0	0.00	0.96	10.0	9.0	15.1	21.2	14.5	12.5
SR03	133.00	1070	56	52	9.8	9.6	27.0	23.0	0.00	0.78	14.0	14.0	31.4	43.8	4.5	3.9
SR04	132.10	1610	40 ^{ns}	42	8.6	8.7	20.5	15.0	0.24	2.04	8.5	4.0	13.8	25.5	25.4	8.2
SR05	130.40	1620	36	36	8.1	8.4	17.0	15.0	0.00	0.00	5.5	2.0	8.0	15.9	20.9	18.7
SR06	129.40	1620	53	47	10.6	9.9	38.5	31.0	0.00	0.00	17.0	15.5	30.3	30.3	4.6	3.0
SR07	127.70	1620	51	49	11.1	10.6	40.5	37.0	0.10	0.74	20.5	18.0	33.7	23.0	5.8	6.3
SR08.2	127.40	1620	43	36*	9.4	9.3	23.0	24.0	0.00	1.03	7.5	7.0	12.1	12.8	13.0	11.3
SRJPMZ	127.00	1620	31	26	8.2	7.9	9.0	6.0	0.00	0.00	3.5	2.0	6.5	20.4	4.8	0.0
SR08	126.55	1630	50	44	10.3	9.8	34.0	28.5	0.00	0.43	16.5	12.0	20.0	21.4	11.6	9.9
SR09	125.20	1640	40 ^{ns}	36*	9.6	8.9	20.5	18.5	0.58	0.00	4.0	6.0	3.5	12.3	10.4	8.7
SR10	124.40	1670	51	50	10.6	10.0	35.0	30.5	0.45	0.00	16.0	12.0	38.7	31.6	4.6	3.6
SR11	120.10	1700	52	48	10.5	10.5	32.5	33.5	0.00	0.75	14.5	14.5	22.9	25.7	3.6	6.3
SRCSMZ	118.10	1710	40	28	9.5	7.6	17.5	12.0	0.00	2.50	6.0	2.0	18.7	5.2	16.0	19.7
SR12	118.00	1710	49	47	11.0	10.2	29.0	26.0	0.16	2.52	13.5	12.0	34.9	39.5	4.0	2.2
SR13	117.15	2260	51	50	10.0	10.5	25.0	31.0	0.00	1.58	10.0	14.5	34.5	37.4	5.0	2.6
SR14	116.00	2270	54	49	11.1	10.7	35.5	32.5	0.00	0.16	16.5	17.0	39.9	44.5	0.5	0.8
SR15	114.00	2280	51	48	10.7	10.3	34.0	36.0	0.61	0.89	17.5	18.5	46.4	56.7	2.5	3.6
SR16	109.35	2310	45 ^{ns}	50	10.5	10.5	31.5	34.5	0.37	0.35	13.5	17.5	30.5	53.1	0.6	1.1
SR17	107.50	2320	50	48	10.3	10.2	28.5	28.0	0.28	1.14	13.5	15.5	34.8	45.8	1.9	2.3
SR18	105.25	2610	47	48	10.6	9.6	29.5	27.0	0.14	1.30	10.5	14.5	26.0	48.8	2.0	0.4
SR19	102.00	2640	51	49	10.6	9.8	35.0	29.0	0.19	0.39	19.5	15.5	46.6	68.6	1.5	1.1
SR20	100.24	3200	52	50	10.5	9.5 ^{ns}	38.0	30.5	0.00	0.00	15.5	14.5	24.0	20.2	2.8	2.3
SR21	99.52	3220	52	48	10.2	9.5 ^{ns}	35.5	33.0	0.00	0.00	18.5	17.0	38.2	35.0	3.1	3.7
SR22	98.65	3220	46 ^{ns}	46 ^{ns}	9.6	9.3 ^{ns}	27.0	22.5	0.00	0.00	12.0	8.5	14.6	26.9	6.0	9.9
SR23	98.01	3220	50	51	10.9	10.0	40.0	32.5	0.14	0.00	22.0	18.0	45.6	60.2	3.0	2.3
BW06	9.80	547	54	49	10.1	10.7	37.0	36.5	0.00	0.00	20.0	21.5	59.0	55.2	6.7	7.5
Narrative Ranking Thresholds	Excellent		44-60		>9.1		>25		0.0		>15		>30		<15	
	Good		38-43		8.0-9.0		>14		<0.1		11-15		>20-30		>15-30	
	Fair		26-37		5.8-7.9		>10		<1.3		3-10		>10-20		>30-50	
	Poor		19-25		4.0-5.7		>7		>1.3		1-2		>5-10		>50-70	
Very Poor		12-18		<4.0		≤7		>10		0		<5		≥70		

Footnotes: a Narrative rating used in lieu of ICI (E - Exceptional; G - Good; F - Fair; P - Poor; VP - Very Poor. b As defined by Yoder and Rankin 1995) and Yoder and DeShon (2003).

(1998). There are three derivations of the fish IBI that are applied to Ohio inland rivers and streams – a headwater sites IBI for streams draining less than 20 square miles, a wadeable IBI for sites that are sampled with wading methods that drain greater than 20 square miles, and boatable IBI for sites that are sampled with boat methods. These are distinct site types that also have their own biological criteria based on independent sets of reference sites. The biological criteria are further stratified by the five Level III ecoregions that occur across Ohio for the WWH use designation, but are applied on a statewide basis for the EWH use designation.

The mean fish IBI (based on two sampling passes) either fully met, surpassed, or was within the nonsignificant departure of the existing or recommended biocriterion at all except two sites in 2022 (Figure 22). All except two sites met or surpassed the WWH biocriterion of 42 where the mainstem is currently designated WWH. The IBIs of 36 at the sites at the OARS bypass (RM 127.5, SR08.2) and adjacent to the Shelly Materials quarry (RM 125.3, SR09) were in significant departure of the WWH IBI biocriterion by only two IBI points. The mean IBI of 36 in the Greenlawn Dam impoundment easily met the MWH biocriterion and was barely in significant departure of the WWH biocriterion. Ten (10) of the 11 mainstem sites downstream from Big Walnut Creek fully met or surpassed the EWH IBI biocriterion. The single site within the nonsignificant departure from the IBI EWH biocriterion of 48 occurred at SR22 (RM 96.35) where the results was 46 only two points below the biocriterion of 48. The same result was observed in 2020.

The Modified Index of Well-Being (MIwb) is the second of two fish assemblage measures that comprise the Ohio biological criteria. At first it was the only Ohio EPA fish assemblage assessment index and originally calculated as the Index of Well-Being (Iwb) developed by Gammon (1976, 1981) which predated the development of the IBI in the latter one-half of the 1980s. The original Iwb was modified by Ohio EPA (1987) as the MIwb to reduce the potentially misleading and inflating effect that tolerant and other irruptive species had on the numbers and biomass components of the MIwb. This was addressed by removing species designated as highly tolerant from the numbers and biomass metrics of the MIwb. This resulted in a better fit with the biological condition gradient model that was initially developed and further refined by extensive testing during subsequent stream and river bioassessment (Ohio EPA 1987; Yoder and Smith 1999). The MIwb is now used as a complimentary assessment along with the IBI meaning it should not be used alone to assess fish assemblage attainment of the Ohio biological criteria. It is a measure of fish assemblage diversity and productivity and it generally pre cedes the IBI in showing improvements in response to lessening environmental stressors, particularly those related to organic and nutrient enrichment. It has been quite sensitive to acutely toxic impacts where fish numbers and biomass of all species are sharply reduced.

The mean MIwb (based on two sampling passes) in 2022 either fully met or surpassed the applicable and recommended use designations (Figure 22). It surpassed the WWH biocriterion by 0.5-1.0 units at all sites in the upper mainstem and surpassed the MWH biocriterion by 2.0 units in the Greenlawn Dam impoundment (RM 129.9, SR05). With only one exception of three sites in the lower mainstem (SR20, 21, and 22) it met or surpassed the EWH biocriterion at all sites downstream from Jackson Pike and all the way to Circleville.

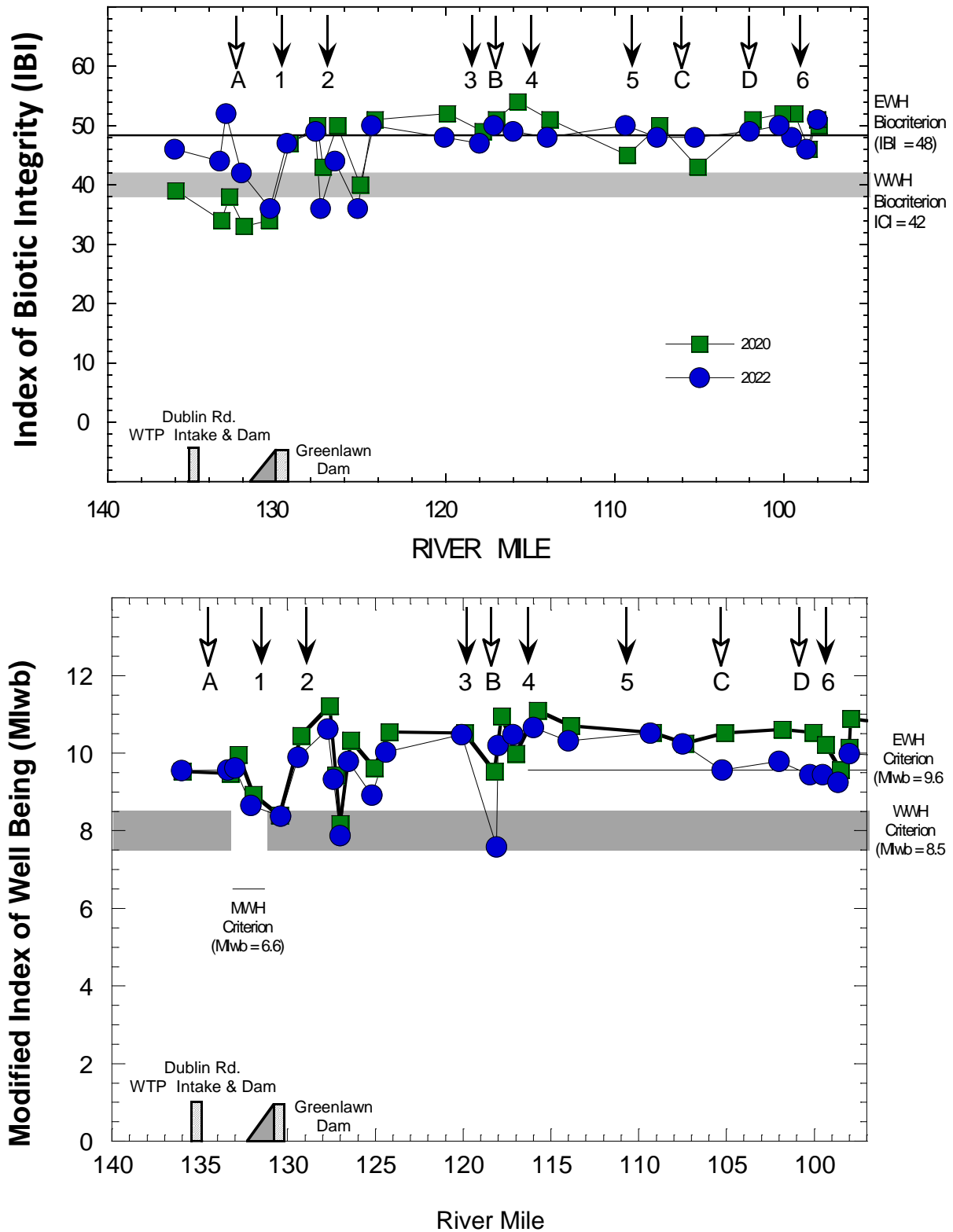


Figure 22. Mean fish Index of Biotic Integrity (IBI) scores for boatable sites (upper) and Modified Index of Well-Being (MIwb) scores (lower) in the middle Scioto River mainstem July-Oct. 2020 and 2022. Major tributaries (letters) and discharges (numbers) are indicated along the top of the graphic.

The effect of the proportion of Gizzard Shad by numbers on the IBI score was not as marked in 2022 as it was in 2020. The 2020 analysis showed that when Gizzard Shad exceeded 30% of the sample by numbers the resulting IBI score was 4 units or more *lower* than without Gizzard Shad. The interpolated change point was approximately 28% based on a regression of the difference in IBI scores with and without Gizzard Shad (MBI 2022). The 2020 and 2022 IBI scores were calculated with and without Gizzard Shad to determine the effect on attainment of the IBI biocriterion. Doing this brought the 2020 mean IBI all sites downstream from Big Walnut to within the non-significant departure of the EWH biocriterion. Excluding such temporally occurring irruptive effects from such species that can occur in large schools is permitted by the original Ohio EPA (1987) documents and subsequent revisions (Ohio EPA 2015). As a result the IBI values without Gizzard Shad were used to determine attainment of the existing and recommended use designations in 2020 and 2022. While the numbers and proportions of Gizzard Shad for all years sampled 1979-2022 show an overall general decline (Figure 23) the episodic occurrence of this schooling species can mask the results of a single sample IBI value to the point it becomes an issue in determining IBI attainment status. The 2020 results below Greenlawn Dam showed a slight uptick in both numbers and percentage of gizzard shad, but still well below historic levels in the 1980s. The percentage and numbers of this species were higher above Greenlawn Dam than below in both 2020 and 2022, a reflection of the proximity to impounded reaches and former impoundments. The abundance and proportion of the assemblage of this species bears close monitoring as an indicator of nutrient enrichment and potentially climate change related effects into the future.

DELT Anomalies

DELT anomalies is a metric of the Ohio fish IBI and is measured as the percentage of fish in a sample that exhibit a deformity (D), an erosion (E), a lesion (L), or a tumor (T) based on an external examination while processing a sample (Ohio EPA 1987; Sanders et al. 1999). It is unique among the IBI metrics in being the only direct indicator of fish health and it has served to be an indicator of different types of impacts in Ohio rivers and streams (Yoder and Rankin 1995b; Sanders et al. 1999; Yoder and DeShon 2003). The percentage of fish with one or multiple DELT anomalies in the middle Scioto River mainstem was zero at only nine (9) of 27 sites in 2022 compared to 16 sites in 2020 (Table 20). The values were less than the 0.1% threshold for a maximum IBI metric score of 5 at nine (9) of 27 sites and greater than 1.3% and a metric score of 1 at four (4) sites with the highest value of 3.12% at RM 136.50 (SR01). A total of 12 sites were in the >0.1 to 1.3 range which results in a metric score of 3. The 2022 results were elevated over the 2020 results especially at the upper four sites between Griggs Dam and the Olentangy River confluence, downstream from Columbus Southerly, and site SR18 (RM 105.25) downstream from Walnut Creek (Figure 24). While historically low, DELTs were elevated in 2022 compared to 2020 and 2015 indicating increased chronic stresses in the reaches where DELTs exceeded the 1.3% threshold for a metric score of 3 and 1. DELTs spiked in 2004-5, but have remained low until 2022.

Biological Assemblages – Macroinvertebrates

The macroinvertebrate assemblages of the Scioto River mainstem between the upstream site

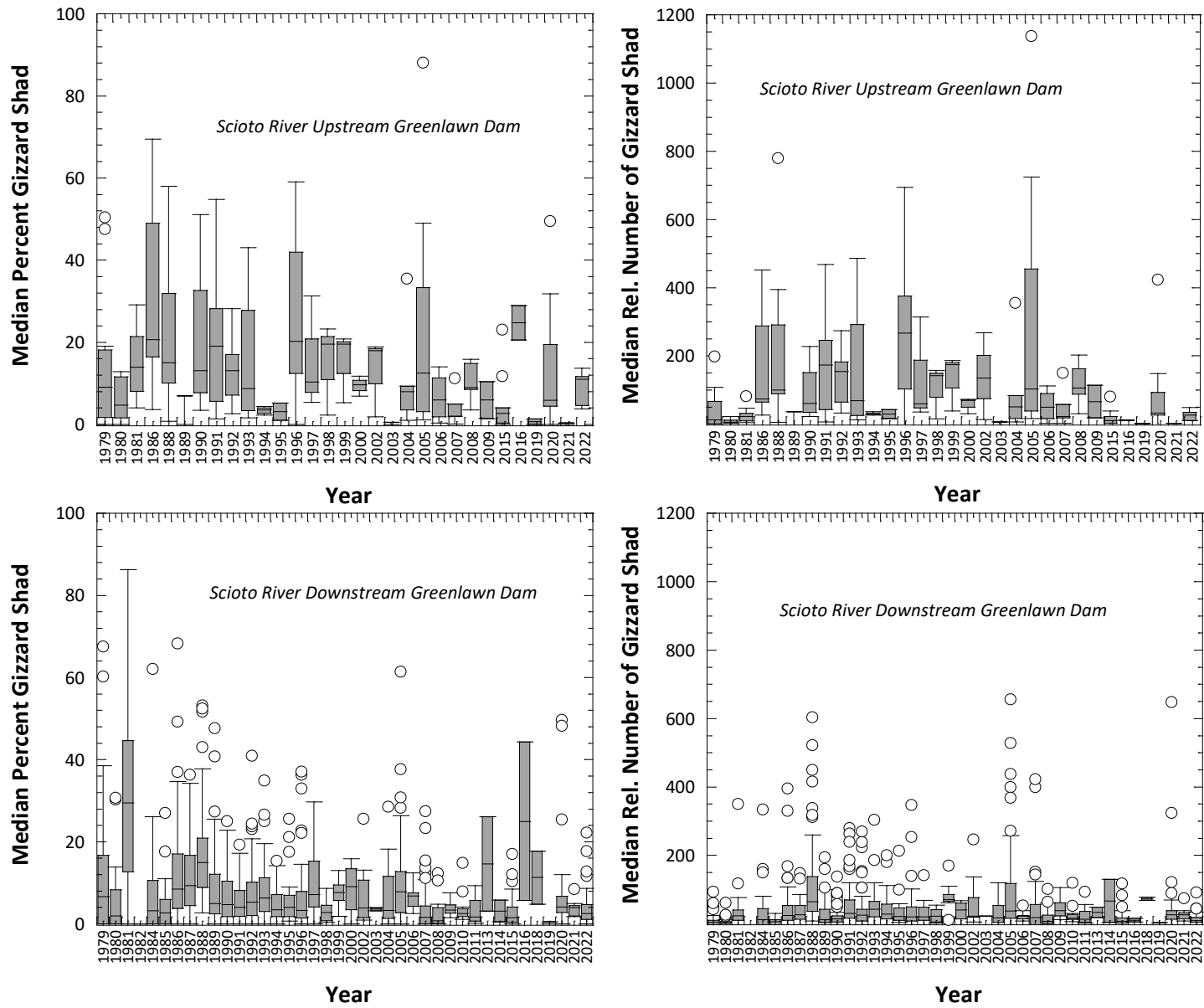


Figure 23. Median, 25th, and 75th percentile percentages and numbers/km of Gizzard Shad in the middle Scioto River above (upper graphs) and below Greenlawn Dam (lower Graphs) during 1979-2022.

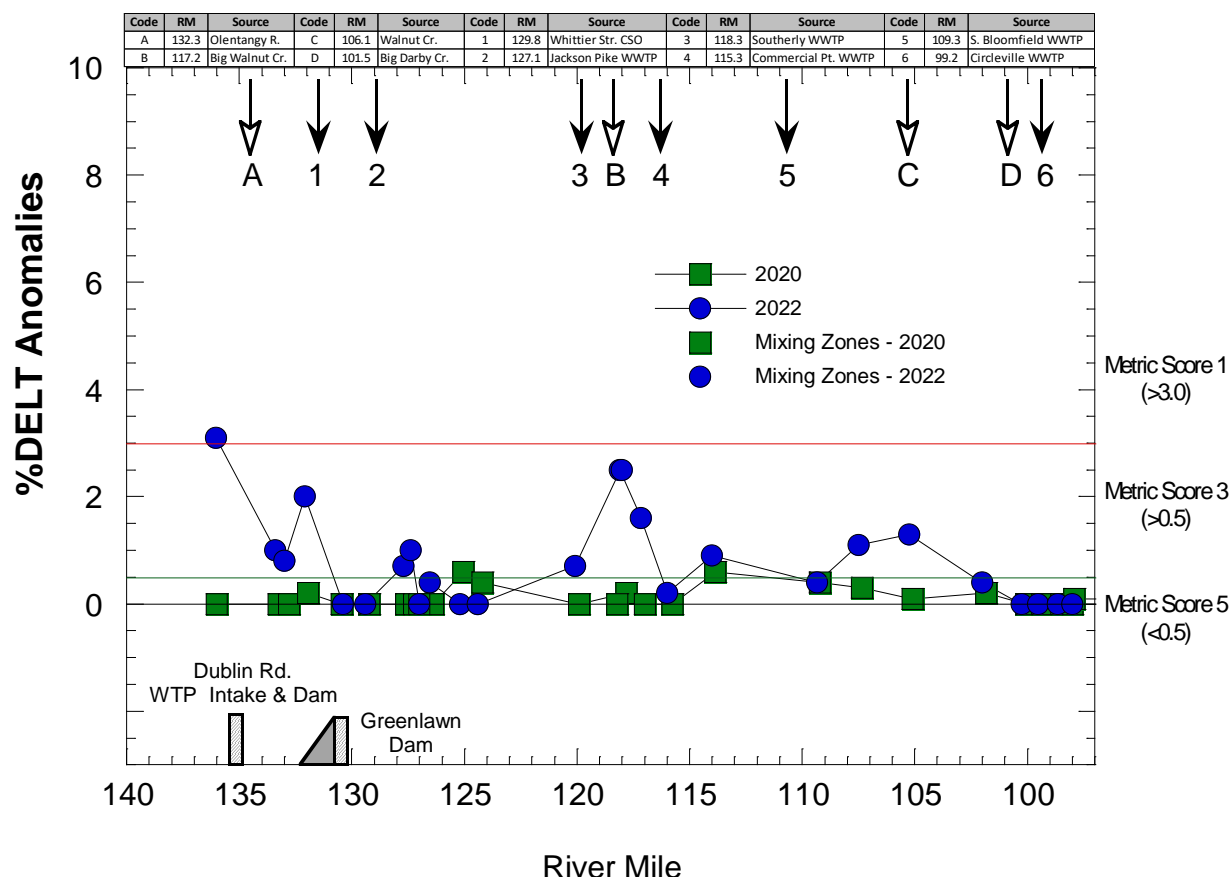


Figure 24. Mean %DELTs in the middle Scioto River mainstem July-Oct. 2020 and 2022. Major tributaries (letters) and discharges (numbers) are indicated along the top of the graphic.

downstream from Griggs Reservoir to Circleville has been assessed in 13 of the past 39 years based on a systematic collection of data between 1981 and 2020. The data has been periodically reported by Ohio EPA in at least three subsequent biological and water quality reports (Ohio EPA 1986, 1999b, 2012). Macroinvertebrate data was collected at fewer sites in 1974, 1976, and 1977 and these data are included in the historical trend results. The 2022 survey is the most comprehensive since the MBI surveys of 2015 and 2022 and Ohio EPA in 2009-10. The 2022 data adds to the existing trend analyses of assemblage indices and attributes. Summarized data tables for 2022 appears in Appendix C.

2022 Macroinvertebrate Assemblage Results

A total of 219 macroinvertebrate taxa were collected from the modified Hester-Dendy (HD) artificial substrate samplers and in the qualitative dip net, handpick samples in the Scioto River mainstem downstream from Greenlawn Dam and 150 taxa upstream from Greenlawn to Griggs Reservoir and including the Olentangy River downstream from Dodridge Dam in 2022 (Appendix Tables C-1 and C-2).

Macroinvertebrate Assemblage Composition – Upstream Greenlawn Dam

The HD samplers yielded 88,365 organisms across 69 taxa while the qualitative samples yielded

124 taxa. The top 40 taxa upstream from Greenlawn included 9 sensitive (intolerant and moderately intolerant) taxa, 24 facultative taxa, three (3) tolerant taxa, and four moderately tolerant taxa. There were five (5) Trichoptera (caddisflies) and 10 Ephemeroptera (mayflies) taxa for a total of 15 EPT taxa. There were 18 Dipteran midge (Chironomidae) taxa with an additional midge taxa from the sensitive Tanytarsini Midge tribe. The remaining taxa were non-insects and other Dipterans. The 2022 results were very similar to 2020. Overall the macroinvertebrate assemblage reflected mostly good quality in the Scioto River and lower Olentangy River upstream from Greenlawn Dam.

Macroinvertebrate Assemblage Composition – Downstream Greenlawn Dam

The HD samplers yielded 210,170 organisms across 101 taxa while the qualitative samples yielded 198 taxa. The top 40 taxa downstream from Greenlawn included 18 sensitive (intolerant and moderately intolerant) taxa, two (2) tolerant and four (4) moderately tolerant taxa, and the remaining 16 classified as facultative taxa. There were eight (8) Trichoptera (caddisflies) and eight (8) Ephemeroptera (mayflies) taxa each for a total of 18 EPT taxa, 15 Dipteran midge (Chironomidae) taxa with an additional midge taxa from the sensitive Tanytarsini Midge tribe. The remaining taxa were non-insects and other Dipterans. Overall the macroinvertebrate assemblage reflected mostly good quality in the Scioto River and lower Olentangy River upstream from Greenlawn Dam. Overall the macroinvertebrate assemblage reflected good to exceptional quality in the Scioto River below Greenlawn Dam.

Macroinvertebrate Assemblage Response Indicators

Key macroinvertebrate assemblage response indicators were also examined along the length of the 2022 mainstem and besides the Invertebrate Community Index (ICI) included the number of total taxa, number of sensitive taxa in the qualitative sample, the proportion of tolerant taxa, the proportion of mayflies, the number of EPT taxa in the qualitative sample, the proportion of toxic tolerant taxa, and proportion of organic enrichment tolerant taxa (Table 21). These cover the breadth of assemblage response to chemical, physical, and biological stressors and are based on narrative ranges and thresholds described in Yoder and Rankin (1995) and Yoder and DeShon (2003) and as established by examining box-and-whisker plots of metrics vs. narrative ranges of the ICI/IBI, typically using the 25th percentile metric score at sites within these ICI ranges to set boundaries for metric narrative categories. The qualitative EPT and sensitive taxa narrative ranges are based on Ohio EPA (2015) Table 4 and Figures 4 and 5. These are not necessarily equivalent to the metric scores of the ICI.

The two mixing zone sites accounted for 11 of the 23 total poor and very poor values. All of the poor and very poor indicator responses were observed downstream to the site immediately upstream from the Southerly WWTP (SR 12; RM 118.2) and in the Southerly mixing zone. Only one site, SR12 (RM 118.0) immediately downstream from the Southerly WWTP had a poor value in the lower mainstem. Site SR05 (RM 130.1) in the Greenlawn Dam impoundment consistently had the most poor and very poor values outside of the mixing zones. Fair values persisted in the lower mainstem and with one exception (%organic enrichment tolerant taxa) were all %mayflies. The %mayflies indicator was poor downstream from Griggs Dam (SR01, RM

Table 21. Macroinvertebrate assemblage response indicators in the Scioto River mainstem between Fifth Ave. and Circleville in 2020 and 2022. The results for each indicator are color coded in accordance with the key at the bottom of the table including off shading for non-significant departures for the ICI and ICI narrative.

Site ID	River Mile	Drainage Area (mi. ²)	Macroinvertebrate Assemblage Response Indicators															
			ICI ^a		Total Site Taxa		Sensitive Taxa ^b (Qualitative)		%Tolerant Macros ^b		%Mayflies ^b		Qualitative EPT Taxa ^b		%Toxic Tolerant Taxa ^c		%Organic Tolerant Taxa ^c	
			2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022
Scioto River																		
SR01	136.6	1050	34 ^{ns}	G	58	63	7	13	9.6	3.3	25.1	9.7	10	16	0.4	2.1	28.5	13.9
SR02	133.4	1070	46	MG ^{ns}	60	48	8	8	2.1	0.0	25.9		12	14	0.3		4.7	
SR03	132.6	1070	46	34 ^{ns}	47	45	13	11	1.7	2.2	25.6	13.9	16	13	0.0	0.7	6.3	7.4
SR04	132.1	1610	52	40	58	64	16	14	0.9	0.4	23.9	12.4	17	15	0.0	0.4	1.4	2.4
SR05	130.1	1620	16	6*	40	26	1	0	9.9	1.4	0.8	0.2	2	2	6.4	0.8	86.2	95.3
SR06	129.0	1620	40	G	56	50	20	12	2.7	0.2	0.9	0.8	17	16	1.0	0.0	13.4	92.7
SR07	127.7	1620	44	42	75	57	21	20	3.3	0.9	5.2	2.6	18	19	0.9	0.4	5.7	5.7
SR08.2	127.4	1620	34 ^{ns}	34 ^{ns}	53	64	8	8	16.6	6.9	0.9	2.0	10	13	2.0	5.5	30.1	54.9
SRJPMZ	127.0	1620	16	10	36	38	1	0	64.8	70.8	0.1	0.0	2	2	2.2	0.0	90.1	95.6
SR08	126.5	1630	40	40	59	59	13	6	2.8	0.4	1.8	1.2	12	11	0.9	0.0	13.8	8.1
SR09	125.4	1640	44	40	65	60	17	16	2.1	3.7	8.1	1.2	15	17	0.0	0.0	17.0	8.5
SR10	124.5	1670	48	40	72	61	23	14	1.8	2.8	5.6	2.2	16	13	0.3	0.0	4.7	8.2
SR11	120.1	1700	54	50	67	73	20	25	2.0	0.3	31.5	6.2	20	22	0.7	0.0	3.6	4.5
SRCSMZ	118.2	1710	16	8	32	25	4	1	10.4	8.9	1.3	0.3	4	1	0.0	0.0	84.7	94.9
SR12	118.0	1710	38	44	47	50	12	15	11.2	1.5	11.5	5.8	14	18	1.0	1.2	25.8	9.9
SR13	116.8	2260	46	48	63	74	21	24	1.6	2.5	26.5	17.5	18	21	0.0	1.5	3.5	3.9
SR14	116.0	2270	54	52	67	68	25	21	0.6	0.0	30.0	11.4	19	22	0.3	0.0	2.8	0.4
SR15	114.0	2280	50	52	53	72	19	27	0.8	0.5	28.8	13.7	15	21	0.0	0.5	1.8	2.6
SR16	109.4	2310	52	54	49	62	19	22	0.4	0.0	42.3	20.3	15	20	0.0	0.0	3.2	7.1
SR17	107.5	2320	52	42	54	54	17	17	0.4	0.0	46.5	14.5	17	18	0.0	0.0	5.7	26.7
SR18	105.3	2610	48	56	44	64	18	20	0.3	0.0	23.7	18.5	19	21	0.6	0.0	1.8	4.6
SR19	102.0	2640	52	50	59	68	25	19	0.0	0.5	30.5	19.3	22	18	0.0	0.4	0.8	3.0
SR20	100.1	3200	44 ^{ns}	54	53	62	21	20	0.2	1.1	25.4	17.9	21	18	0.0	0.7	3.8	6.1
SR21	99.4	3220	52	52	60	65	19	23	0.3	0.0	43.9	28.1	17	26	0.0	0.0	1.7	7.0
SR22	99.0	3220	50	46	55	66	20.5	22	0.2	0.8	33.7	14.7	21	20	0.0	0.0	1.9	12.0
SR23	97.9	3220	54	50	67	74	20	21	0.0	0.3	43.0	36.4	21	23	0.0	0.1	2.8	3.9
BW06	9.65	540	42 ^{ns}	46	72	77	18	15	12.0	11.9	30.2	37.2	16	16	0.3	0.0	0.8	1.4
Narrative Ranking Thresholds	Excellent		≥42		>60		>16		≤5		≥30		>15		0		<5	
	Good		32-40		>40-60		11-16		>5-10		>20-30		11-15		<5		<15	
	Fair		14-30		>20-40		6-10		>10-25		>10-20		6-10		<20		≥15	
	Poor		8-12		>10-20		2-5		>25-50		>5-10		2-5		≥35		≥35	
Very Poor		0-6		<10		<2		≥50		<5		<2		<60		>60		

^a - Narrative rating used in lieu of ICI (E - Exceptional; G - Good; F - Fair; P - Poor; VP - Very Poor); ^b - from Ohio EPA (2015a); ^c - as defined by Yoder and Rankin (1995) and Yoder and DeShon (2003).

136.50) and were poor or very poor between the Greenlawn Dam impoundment (SR05, RM 130.4) downstream to the first site downstream from the Southerly WWTP. This “footprint” of low %mayflies coincides with urban parameters that exhibit “footprints” from between Griggs Reservoir and I-270S. The extent of the low %mayflies extends further downstream and also coincides with the Southerly WWTP. However, the most severe responses occur independent of the major WWTPs beginning at Greenlawn Dam and extending downstream from there. The %mayflies do increase downstream from Southerly finally exhibiting excellent quality at SR23 (RM 97.9). The suppression of %mayflies was more extensive in 2022 than in 2020 where values were good or excellent downstream from Southerly, but mostly fair in 2022.

The WWH biocriteria were not applied to mixing zone sites SRJPMZ (RM 127.0) and SRCSMZ (RM 118.2), but the macroinvertebrates were evaluated for indications of acutely toxic conditions as reflected by the community composition and tolerance signatures of selected taxa. Both mixing zone scores were in the lower fair range (ICI = 16), but the overwhelming percentages of taxa were enrichment, not toxic tolerant taxa (Table 36) and not considered indicative of rapid lethality.

The collective responses indicate excessive organic enrichment by the secondary effects of nutrient enrichment and as exacerbated by upstream flow and habitat alterations. The Greenlawn Dam impoundment is the most significant habitat alteration and is a major source of nutrients and the by-products of nutrient enrichment. The free-flowing reach of the mainstem downstream is periodically altered by low flows exacerbated by water withdrawals at the Dublin Rd. WTP and the management of the Delaware Reservoir to maintain summer pool levels. A combination of flow alteration and moderate enrichment effects was evident in the macroinvertebrate responses immediately downstream from the Greenlawn impoundment in 2022 where exceedances of the very poor and poor threshold for %organic enrichment tolerant taxa occurred.

Macroinvertebrate Assemblage Indices and Metrics

The principal macroinvertebrate assemblage index used in Ohio is the Invertebrate Community Index (ICI) developed by Ohio EPA (1987). The ICI is structured similar to the fish IBI being comprised of 10 metrics each calibrated to 6, 4, 2, and 0 metric scores by drainage area on a statewide basis. The ICI biological criteria are codified in the Ohio WQS (OAC 3745-1-07[C] Table 7-1). Their development and usage are detailed in Ohio EPA (1987) with the biological criteria derivation in Ohio EPA (1987, 1989) in DeShon (1995) and its application Yoder (1995) and Yoder and Rankin (1998).

Scioto River ICIs in 2022 met or surpassed the WWH biocriterion at all but the Greenlawn Dam impoundment (SR05, RM 130.4) where the ICI of 6 reflected very poor quality (Figure 25). This was primarily attributed to a combination of impounded habitat with commensurate slow to non-detectable flow velocity and the enriched status revealed by the nutrient assessment. Two (2) sites had ICI scores of 34 and one a narrative of MG, each being a non-significant departure from the WWH biocriterion of 36 (or Good). These included SR02, the site downstream from the Dublin Rd. WTP, the next site at SR03 upstream from the Olentangy River, and the site

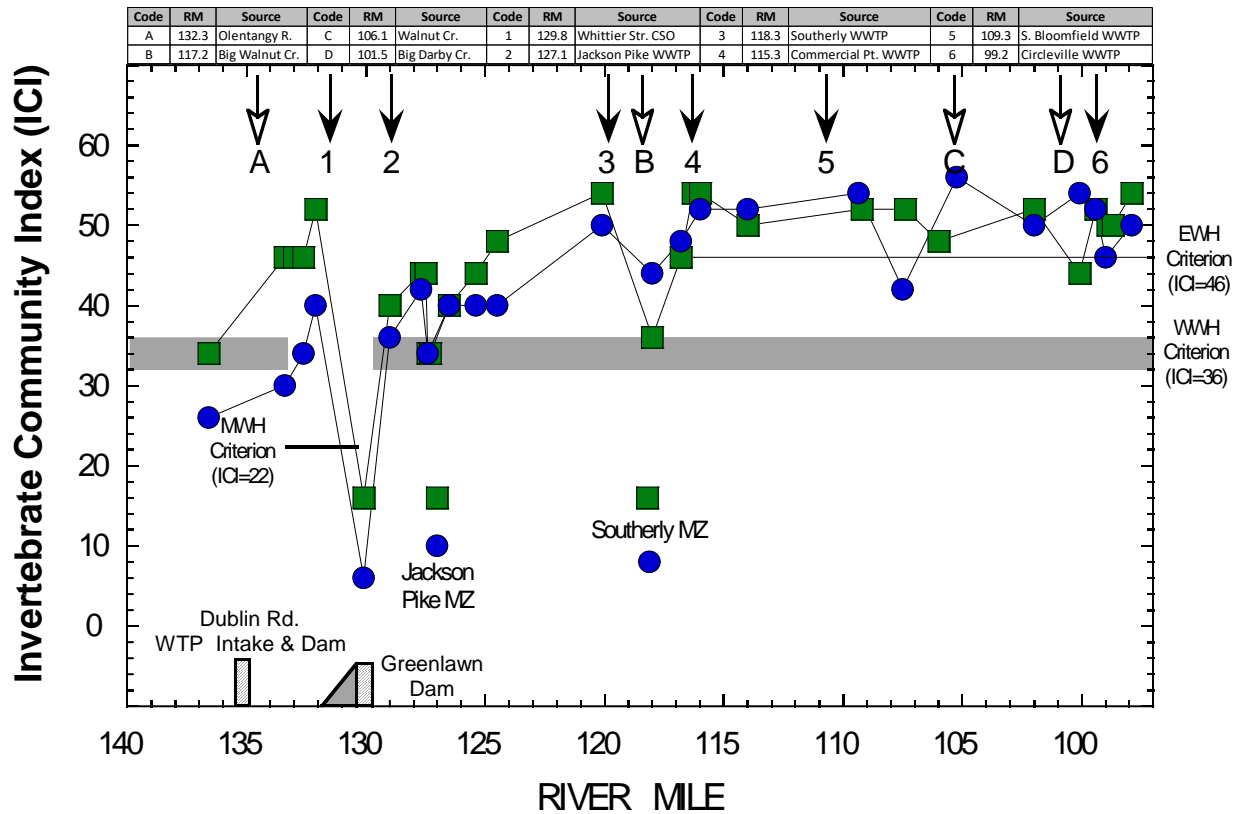


Figure 25. Invertebrate Community Index (ICI) scores for sites in the middle Scioto River mainstem July-Oct. 2020 and 2022. Major tributaries (letters) and discharges (numbers) are indicated along the top of the graphic.

immediately above (SR08.2, RM 127.4) the Jackson Pike WWTP discharge and downstream from the OARS outfall. All other ICIs were well above the WWH biocriterion at the site downstream from Griggs Reservoir (SR01, RM 133.6) and all other WWH designated sites downstream from the Olentangy River. All three sites met or surpassed the EWH biocriterion of 46 in the EWH reach between Big Walnut Creek and Circleville.

The local influence of both the Jackson Pike and Southerly WWTPs were evident in the longitudinal pattern with ICI scores experiencing slight declines immediately below each discharge, but quickly improving with increased distance downstream. Between SR08 (RM 126.5), immediately downstream Jackson Pike, and SR11 (RM 120.1) upstream from the Southerly, the ICI increased steadily, meeting the WWH biocriterion at SR08 and SR09 and surpassing the EWH biocriterion at SR10 and SR11. The ICI briefly declined, but maintained good quality immediately downstream from Southerly at SR12 (RM 118.0). Beginning downstream from Big Walnut Creek (RM 117.2) and extending downstream from Circleville (RM 97.9), all sites met or surpassed the EWH biocriterion of 46. The 2022 results were similar to the 2020 results. Overall, the quality of macroinvertebrate assemblages in free-flowing mainstem reaches in 2022 ranged from marginally good to exceptional in the upper mainstem, below Greenlawn Dam, and below the mixing zones of each WWTP. Macroinvertebrate performance was consistently exceptional from downstream Big Walnut Creek to Circleville.

The number of qualitative EPT taxa followed a longitudinal pattern that was very close to the ICI in 2022 (Figure 26). EPT taxa ranged from a low of two (2) in the Greenlawn Dam impoundment (SR05, RM 130.4) to 26 at SR21 (RM 99.4) upstream from the Circleville WWTP (RM 99.2). Only five (5) sites in the upper mainstem failed to attain the maximum metric score of 6 with the Greenlawn Dam impoundment site nearly scoring 0. The two mixing zone sites also had low numbers of EPT taxa corresponding to the low ICI scores at these same locations.

One ICI metric, %Mayflies, stood out in the comparison of longitudinal trends and was at odds with the overall improvement trends observed in the ICI and qualitative EPT richness in 2022, the same as 2020. The percent mayflies were at very low levels (i.e., in the 0 or 2 metric scoring ranges) between the Greenlawn Dam impoundment (SR05, RM 130.4) and downstream to SR 10 (RM 124.5) in 2020 (Figure 26). This response was extended downstream to SR12 (RM 118.0) in 2022 and beyond with lower values in 2022 compared to 2020 downstream to SR23 (RM 97.9). While both the 2020 and 2022 results showed a consistent improvement downstream from the Southerly WWTP (RM 118.3), the lack of change in the upstream reaches indicates that stressors to which this metric is sensitive remain. The metric has remained in the poor to very poor response range for an approximate 6-7 mile stretch between the Greenlawn Dam impoundment (SR05, RM 130.1) and I-270 South (SR10, RM 124.5) in 2020 and extending to SR12 (RM 118.0) in 2022 (Figure 26). Low %Mayflies occurred in the mainstem between Griggs Dam to downstream of the Southerly WWTP in 2015 and for much of the study area in all years prior to and including 1996. A rapid recovery was observed downstream from the Southerly WWTP in 1981, but all other years prior to 2020 and 2022 were consistently lower and mostly in the 2 and 4 metric scoring ranges (MBI 2022). Mayflies are sensitive to a variety of pollutants, but especially so to elevated levels of dissolved solids (Kefford 2019; Johnson et al. 2014; Pond 2010). However, none of the total dissolved solids levels measured in the mainstem in 2020 and 2022 or prior years approached such levels of concern. Other chemical physical factors that coincided with the very low %Mayfly results in the approximately 9-10 mile SR05 to SR18 reach included the highest median sestonic chlorophyll a levels in the study area, no fast current types (from QHEI data), and the highest number of PAH compound detections in sediment. The lowest %Mayflies occurred upstream (SR05) and downstream (SR06) from the Greenlawn Dam and upstream (SR08.2) and downstream (SR08) from the Jackson Pike WWTP with values consistent with those observed in the Jackson Pike and Southerly mixing zones (Table 21). At sites downstream from the SR05-SR18 reach, an increase in %Mayflies was temporarily interrupted by the Southerly WWTP. This suggests a mix of organic enrichment, habitat, and flow alteration impacts to the abundance of Mayflies. While none of these results affected attainment of the WWH ICI biocriteria outside of the impounded habitats, the observed response is an indication of a continuing impact or a “slowness” in the recovery of this metric despite recent pollution abatement measures such as the OARS project.

The Scioto River Mussel Fauna

A partial assessment of the mussel assemblage is conducted as part of the qualitative sample that is collected at each HD sampling location as part of the macroinvertebrate sampling protocol with species listed alongside the other macroinvertebrates (see Appendix C). It is widely acknowledged that the mussel fauna has been historically and seriously impacted in

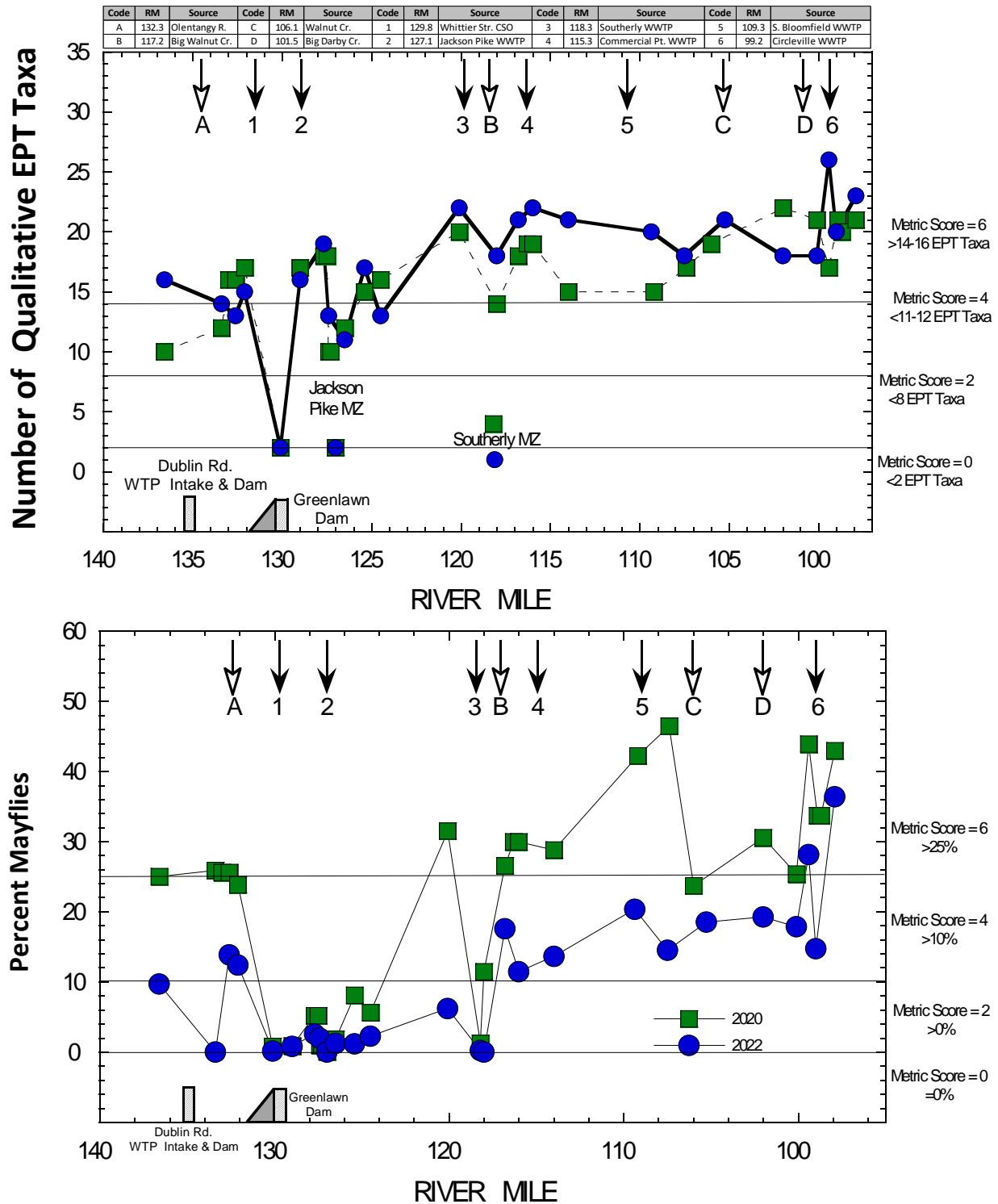


Figure 26. The number of qualitative EPT taxa (upper) and %Mayflies at sites in the middle Scioto River mainstem July-Oct. 2020 and 2022. Major tributaries (letters) and discharges (numbers) are indicated along the top of the graphic.

Ohio and other Midwestern rivers and with only sporadic indications of any meaningful recovery. Freshwater mussels are in the family Unionidae (“Unionids”) and have gained widespread attention due to their historical decline, but also due to recent die offs such as was observed in Big Darby Creek in 2015. Several of the affected species are state and federally listed as endangered and threatened and attempts to recolonize them to their former ranges have only been partially successful. The 2013 U.S. EPA ammonia criteria document bases the criterion largely on mussels as the most sensitive species with a provision that it will apply where mussels occur or have been documented to occur. The Scioto River is listed by the U.S. Fish and Wildlife Service (USF&WS) as a mussel restricted river meaning it has a significant mussel fauna and a high potential for encountering endangered and threatened species. Tetzloff and Akison (1999) cited a 1979 survey by Dr. David Stansbery, OSU that found no living Unionids in the Scioto between Columbus and Circleville, other than a few strays at the mouth of Big Darby Creek and Big Walnut Creek (Stansbery and Lafferty 1979).

Scioto River Mussel Surveys

One of the earliest published surveys is that of Price (1940) that included four locations in the 2022 Scioto River mainstem study area in Franklin Co. out of 34 locations collected county wide. This was a “checklist” survey or simply a documentation of what species occurred at a particular location and produced 25 species across 19 genera. Since that study, there have been only two meaningful surveys that have encompassed significant portions the 2022 Scioto River mainstem study area. The 1999 survey by Tetzloff and Akison (1999) included at least 26 sites between St. Rt. 665 at Shadeville (~RM 120) to Circleville (~RM 100). A subsequent study supported by Columbus DOSD as part of the Wet Weather Management Plan baseline (Columbus DOSD 2005) included only four sites in the mainstem between the Dublin Rd. WTP Dam (RM 133.4) and St. Rt. 762 (~RM 115). There are many other site-specific surveys that are generally limited to a bridge crossing, mussel rescue, or other local activity requiring a federal 404 permit.

The Tetzloff and Akison (1999) survey is the spatially most complete of the recent surveys and also incorporates at least the concept of pollution impacts that have affected the Scioto River mainstem below Columbus as documented by the 2020 biological and water quality survey report (MBI 2022). Between the 21 living or fresh dead mussel species and 36 subfossil species, they documented a total of 43 mussel species in their 20 mile long study area. They concluded that at 21 species, the Scioto presently holds less than half its prehistoric diversity. Moreover, the prospects of a return of missing species are dim, especially in view of declines in the principal mussel refuge Big Darby Creek. However, as recently as 1980 the prospect that the Scioto River below Columbus would support any mussels seemed improbable. While, the number of Ohio streams that are currently experiencing increases in mussel diversity are few, the return of 21 species to the middle Scioto over 20 years was encouraging at that time. Moreover, several pollution-intolerant and state-listed species are apparently thriving in the area. For these reasons there is hope that the Scioto mussel community will continue to see at least modest improvement. To this end the diverse upstream portion of the study area, along with the lower miles of Big Walnut Creek and Big Darby, should be monitored and noted for special protections. Given that these conclusions are now 25 years old and with the only recent

near full recovery of the fish fauna upon which mussels depend for ingress and recovery a more complete mussel survey should be completed to update the current baseline.

Scioto River Mussels 2022

During the collection of macroinvertebrate samples between Frank Road and I-270 South, weathered mussel shells were found in silty muck at the base of a four foot high clay bank (Figure 27). While it is not unusual to find long-dead “sub-fossil” shells along the historically polluted sections of the Scioto River, many of the specimens were very different from the shells that are normally encountered. Most had retained their periostracum, the thin, outer organic layer or “skin” that gives the shells their brownish color and distinctive patterns. Others had unworn bumps and pustules and a few still retained their delicate inner shell lining or “nacre”. More shells were found in additional deposits at varying distances from the bank. These shells were covered with a layer of muck and silt and perched on the shallow, hardpan shelf that extended out into the river channel. At first it was thought that the shells represented a midden or a “garbage dump” of spent shells where, over time, muskrats or raccoons pried apart, ate, and then discarded the empty shells. However, midden specimens usually show evidence of gnawing, showing teeth marks or claw scratches and these specimens had none. It seems more likely the shells were freshly dead, possibly the result of a die-off, and then deposited soon after by a high water event or a flood. It was obvious that the shells did not represent recent populations and most likely were alive before this section of the river became grossly polluted with sewage and other wastes. Species included the rare, but distinct and aptly named, “rabbitsfoot” mussel that is currently restricted to only a few high quality streams in Ohio, including Big and Little Darby Creeks. Numerous “Pleurobema-type” shells were found with their protruding and strongly deflected, beaks or “umboes” at the hinge point. There are a number of different species within this genus, but most in Ohio are listed as rare or endangered by Ohio DNR. As sampling continued, the shells were not only accumulating at the base of the bank, but were buried and protruding from the soft clay layer near the waterline (Figure 27). Within a half hour, dozens of shells were excavated, many of which were in remarkably good condition.

The shells were returned to the MBI lab where they were cleaned, initially sorted, and identified by MBI taxonomists. Other mussel taxonomists from the Ohio State University Museum of Biological Diversity and other organizations were requested to assist with the identifications. Twenty-one (21) species including 16 that are state-listed species of concern, state threatened, federally endangered, or extinct were identified (Table 22). The extinct species is the tubercled blossom pearly mussel (*Epioblasma torulosa torulosa*), a close relative of the endangered northern riffleshell (*Epioblasma torulosa rangiana*). The diversity of shells from this isolated spot along the Scioto River was unprecedented. By comparison, the 21 Scioto River species represents nearly one-half (48%) of the number of species currently found in the entire Big Darby Creek watershed (44). Besides the remarkable diversity of the shell collection and their mostly excellent condition, it has both historic and ecological value. Given the severe

Table 22. Mussel species^a at Scioto River RM 125.4 adjacent to the Shelly Materials quarry downstream from the Jackson Pike WWTP, 2022.

Scientific Name	Common Name	Status (2022)
<i>Alasmidonta marginata</i>	Elktoe	Ohio Species of Concern
<i>Amblema plicata</i>	Threeridge	
<i>Cyclonaias tuberculata</i>	Purple wartyback	Ohio Species of Concern
<i>Elliptio crassidens</i>	Elephant-ear	Ohio Endangered (OE)
<i>Epioblasma torulosa</i> ^c	Tubercled blossom	Extinct
<i>Epioblasma triquetra</i>	Snuffbox	Federal Endangered (FE), OE
<i>Eurynia dilatata</i>	Spike	
<i>Fusconaia flava</i>	Wabash pigtoe	
<i>Fusconaia subrotunda</i>	Longsolid	OE
<i>Lampsilis cardium</i>	Plain pocketbook	
<i>Lampsilis fasciola</i>	Wavy-rayed lampmussel	Ohio Species of Concern
<i>Ligumia recta</i>	Black sandshell	Ohio Species of Concern
<i>Obovaria subrotunda</i>	Round hickorynut	Ohio Threatened (OT)
<i>Ortmanniana (Actinonaias) ligamentina</i>	Mucket	
<i>Pleurobema clava</i>	Clubshell	FE, OE
<i>Pleurobema plenum</i> ^d	Rough pigtoe	FE, OE, Ohio extirpated
<i>Pleurobema sintoxia</i>	Round pigtoe	Ohio Species of Concern
<i>Ptychobranhus fascolaris</i>	Kidneyshell	Ohio Species of Concern
<i>Theliderma (Quadrula) cylindrica</i>	Rabbitsfoot	FT, OE
<i>Truncilla truncata</i>	Deerto	Ohio Species of Concern
<i>Villosa iris</i>	Rainbow	Ohio Species of Concern
^a Identified by: Mike Bolton, Anthony Sasson, Jack Freda, John Tetzloff, Jeff Gordon, Nate Shoobs, and Wendell Haag.		
^b Confirmed by Nate Shoobs, Wendell Haag 2022		
^c Needs to be confirmed. Tentatively identified by Jeff Gordon and Nate Shoobs, December 2022		

water quality degradation that characterized the Scioto River the 19th and first eight decades of the 20th century, the shells are likely not of recent origin. Their deposition appeared related to a high water event and, given the haphazard manner in which so many species were inter-mixed, it likely followed a mass die-off of the mussel populations as the river first became polluted as Columbus developed over the 19th and 20th centuries. Whether this was due “a” die-off or “the” die-off (*i.e.*, the point where conditions below Columbus became so polluted that mussel populations were functionally wiped out) is difficult to definitively answer. To that end, MBI is currently working with DNA experts at Miami University in an attempt to date the shells and hopefully determine their age with better accuracy. Regardless, the shells provide a rare, but fairly accurate glimpse into what populations and conditions were like in Central Ohio before many of its streams and rivers were seriously polluted. This information helps create a more reliable and empirical baseline of pre-settlement conditions in Ohio. While it is not yet possible to “recreate” or recover streams and rivers to a pre-settlement state today, the data provides better resolution to the “scale” to measure the true scope of environmental change in central Ohio over time and better define the ecological consequences of population growth and the extent and severity of water pollution that was the result.



Figure 27. *Upper Left: The exposed clay bank along the Scioto River downstream from Jackson Pike where mussel shells were initially found. Lower Left: Mussel shells embedded in the silt-clay-muck substrate along the shoreline. Upper Right: MBI biologist Jack Freda with a bag of freshly collected shells. Lower Right: Relict mussel shells at the MBI after cleaning.*

Synthesis of Results – Scioto River Mainstem

Conditions for aquatic life and the attainment of aquatic life uses in the Scioto River mainstem in and downstream from Columbus have varied considerably over time being impaired by pollution since Columbus first discharged sewage in 1841¹². Rapid human population growth in the 19th and 20th centuries only accelerated that pollution. Historical accounts of water pollution were based on early pollution investigations (Leighton 1903), qualitative observations of gross sewage impacts such as that described by Trautman (1933, 1977), and the by

¹² The Scioto River first received sewage discharges in 1841 when Columbus constructed the first sewer to discharge into the Scioto River and which expanded as the population increased through the second one-half of the 19th century (<https://www.columbus.gov/utilities/about/Historical-Milestones-for-Wastewater-Treatment-in-Columbus/>).

pioneering bioassessments that employed macroinvertebrates as the sole assemblage (FWQA 1970; Olive and Smith 1975). Each investigation documented extensive and severe impacts from excessive inputs of raw and partially treated sewage that predated CWA mandated controls by more than a century. The extent of impact from Columbus in 1968-69 was estimated to encompass more than 60-75 miles downstream and it was likely more than 100 miles prior to that. The first fish bioassessment was conducted in 1979 (Yoder et al. 1981) and it serves as the baseline for the series of subsequent surveys that culminated in the 2022 bioassessment reported herein which documented only a localized sites of impairments unrelated to the major WWTPs. The success of the continual pursuit of technology-based and later water quality-based permitting occurred via Project 88 with ambient indications of recovery appearing first in the chemical water quality results in the early 1990s followed by the partial attainment of the WWH biocriteria also in the early 1990s (MBI 2022). Increments of improvement towards WWH attainment were observed through that decade and through the 2000s. The potential zenith of recovery was not observed until 2015 and 2020 with attainment of EWH occurring downstream from Big Walnut Creek to Circleville in 2015 and 2020. This result was duplicated in 2022 affirming the maintenance of improved conditions for another seven (7) years. Risks to this status are pending in the form of an increasing population with increased pollutant loadings to the sewage treatment facilities, expansion of urban land uses, and the prospect of emerging contaminants that are being documented locally and across the U.S. The Scioto River mainstem downstream from Columbus is the receptacle for all that occurs in the greater watershed upstream serving as a sentinel of the cumulative response to the anticipated increased stresses and exposures.

Synthesis of the 2022 Results and Key Response Indicators

Table 23 represents a synthesis of the aquatic life use attainment status, the biological criteria by which attainment status is derived, the principal indicators of biological quality and response to the predominant stressors, indicators of habitat quality, key aspects of the D.O. regime that are affected by organic and nutrient enrichment, and the key chemical indicators consisting of water column and sediment chemistry. Each response signature or index score was normalized to their narrative scales of exceptional, good, fair, poor, and very poor quality and condition for each site. As such it presents a synthesis of the results that have were previously described on an individual basis. Use attainment status was either full for WWH or EWH with the exception of the non-attainment of the MWH use in the Greenlawn Dam impoundment and partial attainment at two other sites. In reaches of full attainment certain threats were evident as detailed herein.

The influence of flow modifications in the mainstem between Griggs Reservoir and the Olentangy River confluence were evident in each of the D.O. indicators, the minimum below the minimum WWH criterion at SR01 (RM 136.50) and exceedances of the maximum and diel swings at SR02 (RM 133.40) and SR03 (RM 132.70), the former being influenced by Griggs Reservoir releases and the latter two being additionally influenced by water withdrawals by the Dublin Rd. WTP. Exceedances of PEC and TEC levels of PAH compounds were as frequent as anywhere in the mainstem at SR02 (RM 133.40) and SR03 (RM 132.70), an indicator of the extent of urban runoff. The D.O. indicators were good until the Greenlawn Dam impoundment

Table 23. The status of aquatic life use attainment, biological criteria, habitat, biological response signatures, D.O. indicators of enrichment, and water and sediment chemical exceedances in the Scioto River mainstem and Big Walnut Creek in 2022.

Site ID	River Mile Fish/Macroinvertebrates	Aquatic Life Use Status	IBI	ICI	MIwb	QHEI	Good QHEI Attributes	Poor QHEI Attributes	%DELTA	Sensitive Fish Species	%May-flies	%Toxic Tolerant Taxa	%Organic Tolerant Taxa	Min. D.O. (mg/L)	Max. D.O. (mg/L)	Max. Daily D.O. Swing	Overall Nutrient Box Model Status	Water Column Poor/VP Exceedances	Sediment PAH PEC/SEL Exceedances	Sediment PAH TEL/LEL Exceedances
Scioto River - WWH (Existing)																				
SR01	136.05/136.20	FULL	46	G	9.6	88.0	9	0	0.96	14.0	9.7	2.1	13.9	3.45	12.80	8.54	Acceptable	0	0	0
SR02	133.40/133.40	FULL	44	MG ^{NS}	9.6	84.0	9	3	0.96	9.0				4.78	14.29	7.66	Acceptable	0	2	2
SR03	133.00/132.80	FULL	52	34 ^{NS}	9.6	87.0	9	0	0.78	14.0	13.9	0.7	7.4	7.48	17.25	8.79	Acceptable	0	4	4
SR04	132.10/132.10	FULL	42	40	8.7	68.5	5	6	2.04	4.0	12.4	0.4	2.4	7.77	15.82	7.68	Acceptable	0	6	6
Scioto River - Greenlawn Dam Pool - MWH-I (Existing)																				
SR05	130.40/130.10	NON	36*	6*	8.4	57.0	3	7	0.00	2.0	0.2	0.8	95.3	10.51	24.18	12.60	Over	0	5	5
Scioto River - Dst. Greenlawn Dam - WWH (Existing)																				
SR06	129.40/129.00	FULL	47	G	9.9	86.3	9	1	0.00	15.5	0.8	0.0	92.7	3.53	12.99	5.12	Acceptable	0	4	5
SR07	127.70/127.50	FULL	49	42	10.6	85.5	9	1	0.74	18.0	2.6	0.4	5.7	5.33	12.79	5.98	Acceptable	0	5	5
SR08.2	127.40/127.40	PARTIAL	36*	34 ^{NS}	9.3	62.0	4	7	1.03	7.0	2.0	5.5	54.9	-	-	-	-	0	5	5
SRJPMZ	127.00/127.00	MZ	26	10	7.9	-	-	-	0.00	2.0	0.0	0.0	95.6	-	-	-	-	-	-	-
SR08	126.55/126.50	FULL	44	40	9.8	85.0	9	1	0.43	12.0	1.2	0.0	8.1	6.02	11.91	4.58	Acceptable	2	4	4
SR09	125.20/125.40	PARTIAL	36*	40	8.9	61.5	4	7	0.00	6.0	1.2	0.0	8.5	6.13	13.24	5.54	Acceptable	2	4	4
SR10	124.40/124.50	FULL	50	40	10.0	80.3	8	2	0.00	12.0	2.2	0.0	8.2	6.34	11.93	4.55	Acceptable	2	4	4
SR11	120.10/119.30	FULL	48	50	10.5	86.0	9	1	0.75	14.5	6.2	0.0	4.5	5.90	14.78	6.70	Acceptable	2	4	4
SRC5MZ	118.10/118.30	MZ	28	8	7.6	-	-	-	2.50	2.0	0.3	0.0	94.9	-	-	-	-	-	-	-
SR12	118.00/118.00	FULL	47	44	10.2	72.5	8	3	2.52	12.0	5.8	1.2	9.9	6.58	13.31	5.22	Acceptable	2	0	0
Scioto River - Dst. Big Walnut Creek - EWH (Existing)																				
SR13	117.15/116.90	FULL	50	48	10.5	84.0	9	2	1.58	14.5	17.5	1.5	3.9	7.07	11.60	3.98	Acceptable	1	2	2
SR14	116.00/116.00	FULL	49	52	10.7	86.5	9	1	0.16	17.0	11.4	0.0	0.4	6.80	12.19	4.54	Acceptable	1	0	0
SR15	114.00/115.00	FULL	48	52	10.3	84.5	9	1	0.89	18.5	13.7	0.5	2.6	6.80	12.25	4.36	Acceptable	1	0	0
SR16	109.35/109.20	FULL	50	54	10.5	84.0	9	1	0.35	17.5	20.3	0.0	7.1	6.50	11.38	3.91	Acceptable	1	2	2
SR17	107.50/108.50	FULL	48	42	10.2	77.0	8	3	1.14	15.5	14.5	0.0	26.7	6.92	11.89	3.30	Acceptable	0	0	0
SR18	105.25/106.00	FULL	48	56	9.6	79.8	9	1	1.30	14.5	18.5	0.0	4.6	7.19	11.62	2.92	Acceptable	0	0	0
SR19	102.00/102.00	FULL	49	50	9.8	81.5	9	1	0.39	15.5	19.3	0.4	3.0	6.21	11.85	3.86	Acceptable	1	0	0
SR20	100.24/100.10	FULL	50	54	9.5 ^{NS}	93.5	9	0	0.00	14.5	17.9	0.7	6.1	6.77	12.58	4.68	Acceptable	0	0	0
SR21	99.52/99.40	FULL	48	52	9.5 ^{NS}	89.8	9	0	0.00	17.0	28.1	0.0	7.0	6.33	20.38	12.49	Acceptable	1	0	0
SR22	98.65/99.10	FULL	46	46	9.3 ^{NS}	74.5	6	4	0.00	8.5	14.7	0.0	12.0	-	-	-	-	1	0	0
SR23	98.01/97.90	FULL	51	50	10.0	92.5	9	0	0.00	18.0	36.4	0.1	3.9	6.53	15.05	5.92	Acceptable	0	0	0
Big Walnut Creek - EWH (Existing)																				
BW06	9.80/9.50	FULL	49	46	10.8	83.5	9	0	0.00	21.5	30.2	0.0	1.4	-	-	-	-	0	0	0
Narrative Threshold Rankings	Exceptional	FULL	44-60	>42	>9.1	>75	>9	<1	0.00	>15	>30	0.0	<5	-	-	-	-	0	0	0
	Good	FULL	38-43	32-41	8.0-9.0	60-74	>6	<4	<0.1	11-15	>20-30	<5	<15	>4	<12	<7.0	Acceptable	1.0	0.0	<4
	Fair	PART./NON	26-37	14-30	5.8-7.9	46-59	>4	<5	<1.3	3-10	>10-20	<20	>15	<4	>12	7.0-8.9	Enriched	2	1	<7
	Poor	NON-Poor	19-25	8-12	4.0-5.7	30-45	>2	>6	>1.3	1-2	>5-10	>35	>35	<2	>15	>9.0	Over Enriched	3	3	<10
	Very Poor	NON-V. Poor	12-18	0-6	<4.0	<30	<1	>7	>10	0.0	<5	<60	>60	-	-	-	-	4	5	>10

at SR05 (RM 129.90) that had the only over-enriched results and where all except two indicators were in the fair, poor, or very poor ranges. The poor and very poor percent mayflies metric response between the Greenlawn Dam impoundment downstream to site SR10 (RM 124.50) was independent of a major discharge and coincides with the position of the Greenlawn Dam and the reach immediately downstream that is subject to general urban, flow, and habitat modifications that appear to extend below the Jackson Pike discharge. This reach was historically impacted by a CSO discharge, but those were addressed in 2015 by the OARS project that eliminated bypasses from the Whittier Street CSO immediately downstream from the dam. While there are some nutrient related responses in the D.O. indicators at two sites, these did not extend below Jackson Pike. At this point the response, while longitudinally consistent and connected, is not entirely diagnosed. There were distinct biological responses to organic enrichment in the mixing zones of each WWTP, but these were confined to those sites. DELT anomalies on fish were elevated in 2022 compared to 2020 especially at the upper four sites between Griggs Dam and the Olentangy River confluence, downstream from Columbus Southerly, and site SR18 (RM 105.25) downstream from Walnut Creek (see Figure 24). While historically low, DELTs were elevated in 2022 compared to 2020 and 2015 indicating increased chronic stresses in the reaches where DELTs exceeded the 1.3% threshold for a metric score of 3 and 1. DELTs spiked in 2004-5, but have remained low until 2022.

There was only one exceedance of any water column criterion, minimum D.O. at SR01 (RM 136.50) below Griggs Dam. There were numerous exceedances of sediment PAH compounds at the next two sites downstream. The highest levels were found in the most urbanized reaches of the mainstem between Griggs Dam and upstream from Southerly (SR11, RM 120.10). Unlike in 2020, the PAH exceedances did not pick up again in and downstream from the Southerly mixing zone. The few exceedances downstream were of the lesser TEC which is likely more indicative of the presence of PAH compounds in urban runoff and not at levels that would result in a biological impairment alone. Taken together the combined biological, habitat, and chemical responses lessened with distance downstream from downtown Columbus and declined altogether downstream from Southerly. The only responses that were directly related to the WWTP discharges was two maximum D.O. values and one diel D.O. swing upstream and downstream from Circleville, some 16-17 miles below Southerly. Overall biological performance was consistently exceptional in the reach below Big Walnut Creek hence the acceptable rating in the nutrient box model. Habitat has been consistently stable through the 40 year period, but improving in the localized reach affected by the Main Street dam removal.

While all of the mainstem except for the Greenlawn Dam impoundment and two isolated instances of partial attainment at SR 08.2 (RM 127.7) and SR09 (RM 125.5) in 2022, the attainment status has been consistently full at all other sites since 2015. Still, distinct reaches with evidence of stresses that constitute varying levels of potential threat include:

- The Greenlawn Dam remains chronically impaired for the MWH use, a repeat of the same result in 2020. The principal cause is the impounded habitat and altered flow regime with each exacerbating the effect of nutrient over-enrichment on the D.O. regime. Reversing this impairment, short of removing the Greenlawn Dam itself, would

require substantial and perhaps unattainable reductions in nonpoint source loadings of both urban and agricultural origin plus restoring the natural flow regime which also seems unlikely given the already existing demands for drinking water and recreation pool maintenance in the Delaware Reservoir.

- The reach between Griggs Reservoir and the Olentangy River confluence has exhibited marginal attainment of the macroinvertebrate assemblage in particular and with symptoms of marginal D.O., indications of nutrient enrichment in high D.O. levels and wide diel swings, elevated DELTs, and exceedances of the higher PEC/SEL thresholds for PAH compounds. This is indicative of a mix of enriched inputs from the Griggs Reservoir, and indirect effects of flow alterations.
- The general reach between Greenlawn Dam to between I-270S and the Southerly WWTP exhibited several indicators of stress including reduced Mayfly abundance, elevated DELT anomalies, and a few sites with elevated organic tolerant taxa. There were no indications of D.O. exceedances, but exceedances of the higher PEC/SEL thresholds for PAH compounds. The distance of these effects expanded in 2022 compared to 2020 where it was restricted to I-270S. The Greenlawn Dam spatially appears to be a major source and it was more severely impaired in 2022 than in 2020 possibly extending the urban footprint further downstream in 2022 than in 2020.
- The reach downstream from the Southerly WWTP downstream to Circleville exhibited more indications of stress in 2022 than in 2020 with reduced Mayfly abundance and moderately elevated DELTs on fish. There were no other chemical indicators other than a few elevated maximum D.O. values which reached levels almost comparable to the Greenlawn Dam impoundment at the two sites downstream from Circleville.
- The site downstream for Walnut Creek has exhibited a few perhaps more subtle indications of stress including elevated DELTs, reduced Mayfly abundance, and high proportions and abundance of Gizzard Shad, which in 2020 caused the IBI to perform less than the EWH biocriterion. This merits further investigation.

In terms of trends the biological improvements have been consistent and incremental since the late 1960s and early 1970s which correspond to incremental improvements in wastewater treatment by the City of Columbus. Whether the 2015, 2020 and 2022 results represent the zenith of potential improvement remains to be seen. Strong declines in ambient levels of ammonia-N, BOD₅, and TKN downstream from Columbus are consistent with reduced carbonaceous and nitrogenous loadings from the two WWTPs after Project 88. While sufficient data was lacking, it is also likely that levels of toxics such as heavy metals declined in a similar manner. Declines were also evident in maximum nitrate-N and total P, although ambient levels of each showed distinct patterns of increase in median values relative to upstream levels below Jackson Pike and less so below the Southerly WWTP in 2020 and 2022. Slight to moderate declines were also evident for temperature, mean nitrate-N, and TSS, the latter reflecting a decline from point sources leaving the remainder to be more affected by nonpoint source loadings. Increases were observed in pH (slight), conductivity (moderate), and chlorides, the latter showing the strongest increase in mean values. The conductivity and chloride increases reflect a long term trend of increases in ionic strength variables, the result of increased urbanization, roadways, and the sewage waste stream in general. While none of the levels

observed in 2020 and 2022 are an immediate threat, the resiliency of such compounds is concerning as they do not biodegrade and are being added to the watershed on a continuing basis. Acting to contain these sources now is essential to preventing future impairments that will be difficult if not impossible to reverse.

RESULTS AND DISCUSSION – OLENTANGY RIVER MAINSTEM

Chemical/physical water quality in the 2022 Olentangy River study area was characterized by grab sample data collected from the water column six times at each site during base flows and within a June 16-October 15 seasonal index period at 11 sites between Powell Rd. and the mouth. Continuous measurements were made with Datasondes over 3-4 consecutive day periods at eight (8) mainstem sites in late July and early August. The Datasonde at OLN05 (RM 14.90) was deployed continuously between mid-July and mid-September. Sediment chemistry was determined from samples collected at all mainstem sites in mid-October.

The results were evaluated by assessing exceedances of criteria in the Ohio WQS, by exceedances of regionally derived biological effect and reference thresholds (Ohio EPA 1999a, 2020; Miltner 2018, 2021) for parameters that lack formal criteria in the WQS, and by exceedances of probable and threshold effect (PEC/SEL and TEC/LEL) levels for sediment chemistry (Persaud et al. 1999; MacDonald et al. 2000). The chemical/physical results also serve as indicators of exposure and stress and in support of the biological data for assessing the attainment of aquatic life uses and assigning associated causes and sources for impairments. Bacteria data were collected via grab samples at all sites and were used primarily to determine the status of recreational uses in accordance with the Ohio WQS. Ohio EPA protocols for determining attainment of the applicable designated recreational use were followed.

Flow Regime

The flow regime in the Olentangy River mainstem the period May 1 – October 31 during 1999, 2003, 2020, and 2022 is depicted (Figure 28) based on the gauge operated by the U.S. Geological Survey at Olentangy Parklands in Worthington (USGS 03226800). These years represent the most recent and complete Ohio EPA surveys and the 2020 and 2022 DOSD surveys and Ohio EPA 1999 and 2003 with each representing a slightly different periodicity of both high and low flows. The flow regime in the Olentangy River mainstem is heavily influenced by flow releases by the Delaware Dam approximately 15 miles upstream. The Delaware Dam can provide for sustained elevated flows, especially if runoff in the upper watershed in Delaware, Marion, and Wyandot Counties is elevated, to maintain the summer recreational pool in the Delaware Reservoir. The summer-fall flow regime in 2022 was “average” with extended periods of flows below the 50th percentile between the mid-June to mid-October index period, but above the 90th percentile flow except one brief excursion in early October. For reference the 50th percentile flow at the USGS Worthington gage of 153 cfs (cubic feet per second) is 5.5 times the 90th percentile flow of 27.8 cfs and nearly 20 times the Q_{7,10} flow of 7.97 cfs. Wasteload allocations (WLA) for point sources are based on the Q_{7,10} flow¹³ as a “worst

¹³ Some WLAs (e.g., ammonia-N) are based on the Q_{30,10} flow.

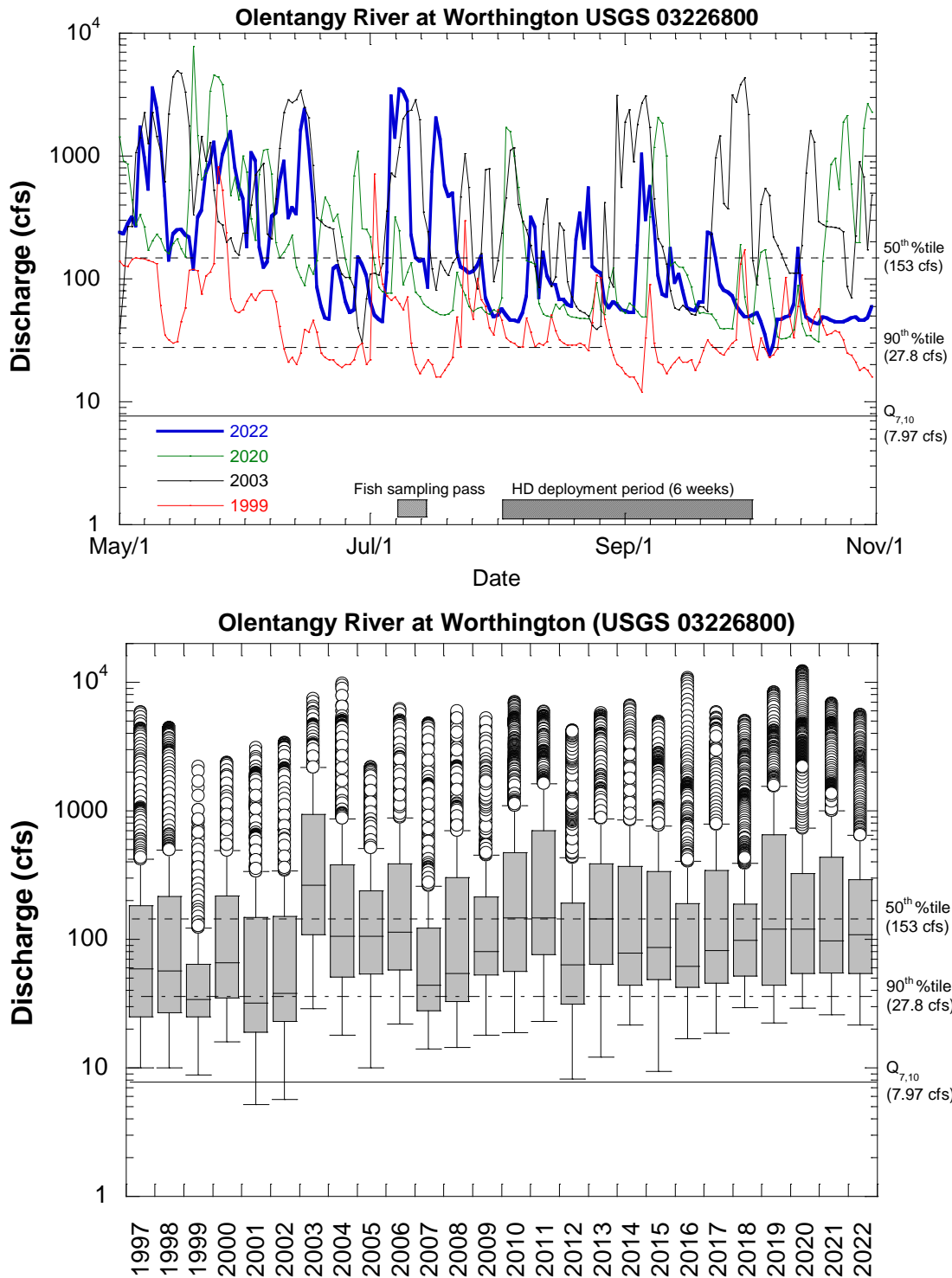


Figure 28. Daily (upper) and annual (lower) flow measured at the USGS gage on the Olentangy River (USGS 03226800at Worthington during May 1-October 31 in 1999, 2003, 2020, and 2022 and as a boxplot for a 26 year period 1997-2022. The horizontal lines are the 50th percentile (median), the 90th percentile, and the seven-day, ten year (Q_{7,10}) critical low flows as determined by USGS (Johnson and Metzker 1981). The span of biological data collection in 2022 is indicated by shaded bars.

case” condition. Compared to the historical survey years of 1999 and 2003, minimum flows were lower in 1999 and were consistently below the 90th percentile flow of 27.8 cfs. Flows were the highest among the four survey years in 2003 (MBI 2022). The most recent year of below critical low flows occurred in 1988 outside of the period of record for readily available data.

The variability in the May-November annual flows was assessed by using box-and-whisker plots to determine year to year and long term trends, if any, in summer-fall river flows (Figure 28). As expected, all of the outliers that are two interquartile ranges above the median are due to spates of high flows that occurred in every year. The median annual flow exceeded the 50th percentile flow in 25 of the 26 years included in Figure 28. By comparison, 22 years had median flows less than the 50th percentile of 153 cfs. Only two years, 2001 and 2002, had minimum flows less than the Q_{7,10} flow of 7.97 cfs while all 26 years had minimum flows less than the 90th percentile flow of 27.8 cfs. No pattern of increase over the 34 year period was evident due to the variability between years.

Major Point Source Pollutant Loadings

The only major point source discharge to the 2022 Olentangy River study area is the Delaware Co. Olentangy Environmental Control Center (OECC) which discharges at RM 13.5. The Upper Olentangy Water Reclamation Center operated by the City of Delaware is located more than 10 miles upstream from the upstream boundary of the 2022 study area in southern Delaware Co. hence it was not included herein. The OECC is an advanced treatment facility with an average design flow of 6.0 million gallons per day (MGD). The treatment plant was originally constructed in 1980, with the most recent major upgrade in 2009. The sewer system is 100% separated from storm sewers. The treatment plant serves the City of Powell, portions of the City of Dublin, and Liberty, Orange, Berlin, and Concord Townships in Delaware County. When it was constructed in 1980 it surpassed the design and treatment standards of that time primarily to enhance the protection of a high quality resource and provide downstream water quality that flowed directly through Columbus neighborhoods. Growth continued over time placing demands on the treatment facility to maintain a high level of ambient water quality.

Olentangy ECC Effluent Loadings Trends

A complete effluent loadings analysis was done for the 2020 report (MBI 2022) for the period 1980-2020 included third quarter (July 1-September 30) results. Effluent flows have steadily increased since the initiation of operations in 1980 with maximum values approaching and exceeding the average design flow of 6.0 MGD since 2000. Median flows have also increased steadily exceeding 2.0 MGD in the late 1990s averaging 3.4 MGD during 2016-22. The median approached 4.0 MGD in 1998 and 2000. The overall increase in effluent flows corresponds to the increased growth of residential areas in southern Delaware County since the ECC initiated operations in 1980. Loadings of cBOD₅ increased steadily from less than 10 kg/day in the early 1980s to more than 20 kg/day by 2020, but well below permitted loadings. Loadings of TSS exhibited a similar pattern to BOD₅ increasing only slightly through the entire 40 year period of operation and well below permitted loadings. Loadings of ammonia-N showed an overall increase with outlier values at or above the 30 day average permitted loadings. Median values

also increased through time as did the variability of the values, but were well below permitted loadings. Nitrate-N loadings were erratic with high values in certain years that exceeded the annual average permitted loading. Outside of these occurrences in 1995-96, 1998-2000, and 2013 the overall trend has been for a slight overall increase with median values well below the permitted loading. Total P has been monitored only since 1997. Maximum values exceeded the annual average permitted loading in 1997-2001, 2005-2008, and 2011. Median values exceeded the permitted loading level twice in 1998-1999, but have generally declined since 2013. The large declines in discharged loadings of BOD₅, TSS, and ammonia-N observed at the Columbus WWTPs after 1988 were not evident for the Olentangy ECC primarily because it was designed to advanced treatment standards when it initiated operation in 1980 well before this level of municipal wastewater treatment had gained wider acceptance in the late 1980s and through the 1990s. Key aspects of the loadings trends do reveal the effects of increased residential growth in the ECC service area since 1980 with increased effluent flow, increased ammonia-N loadings, and slight increases in BOD₅ and TSS.

Olentangy River Mainstem Water Column Chemistry

Water quality was assessed by grab samples collected at all sampling locations six times during the summer-fall index period. Sediment chemistry was collected once at the 11 ambient mainstem sites. Parameter groupings included field, demand, ionic strength, nutrients, heavy metals, and organic compounds. Trends dating back to 1987, 1991, 1999, and 2003 were examined in 2020 along the longitudinal or “pollutional profile” of the mainstem in increments of time (MBI 2022). Both the frequency and consistency of pollution surveys have been fewer than for the Scioto River mainstem even though data has been collected in a piecemeal fashion for single sites or clusters of sites within subreaches of the lower Olentangy River mainstem over several years. Prior to 2020, the most recent and complete Ohio EPA pollution surveys were done in 1999 (Ohio EPA 2001) and 2003 (Ohio EPA 2005). This report focuses on comparison of the 2020 and 2022 results.

Four parameters were monitored continuously over consecutive days during August 8-15, 15-17, and 25-29, 2022 using YSI Datasonde continuous recorders at nine (9) sites. A longer term deployment was made between mid-July and mid-September at site OLN05 (RM 14.90) downstream from Powell Rd. Dissolved oxygen (D.O.), temperature (°C), pH (S.U.), and conductivity (µS/cm) were recorded. Deployments were made during low flows and maximum temperatures as much as was possible. In 2022 the deployments of the Datasonde units were conducted as a mainstem reach survey the same as in 2020. The short-term of the Datasonde deployments being collected under as close to “worst case” conditions for that year provides invaluable insights that cannot be gained from grab sample data alone. It makes an evaluation of compliance with the Ohio WQS for parameters with average and maximum criteria realistic and it fulfills some of the data needed to assess for nutrient effects.

Conventional, Demand, and Nutrient Parameters

Conventional parameters include the most commonly collected parameters in water quality

surveys such as temperature and pH. Total suspended solids (TSS) and conductivity are sometimes included in this group, but for the purposes of this analysis conductivity was considered urban parameters. Demand and nutrient related parameters consist of those related to the discharges of treated and untreated sewage, organic enrichment from point and nonpoint sources, nutrient parameters and their effects, and physical parameters such as total suspended solids each being collected six (6) times during the summer-fall seasonal index period. Benthic chlorophyll a samples were collected once from each site during the short term Datasonde deployments as part of a combined nutrients effect assessment.

Temperature (°C)

Temperature is a critical factor in aquatic systems as it both directly and indirectly influences individual organism health and well-being and various physicochemical processes that also have direct and indirect effects. Fish will avoid lethal temperatures and will seek the temperature regime that each species prefers. Temperature affects chemical rates and processes and the toxicity of certain pollutants (e.g., ammonia-N). While much of the concern with temperature has centered on discharges of heat, modifications and alterations to natural temperature regimes have received increased attention due to climate change.

Temperature was measured at all locations with the collection of each chemical grab sample and during each fish sampling event over the seasonal June-October index period. It was also measured continuously during the short-term deployment of the Datasondes at 9 locations in the lower Olentangy River mainstem. There are no artificial sources of heat discharge to the Olentangy mainstem. However, modifications to flow and habitat can affect or otherwise modify the temperature regime. The temperature criteria in the Ohio WQS consist of monthly average and maximum temperature based on the protection of representative species. The lower Olentangy River falls under the General Ohio River Basin temperature criteria (OAC 3745-1-31; Table 35-11[A]). The summer (June 16-September 15) average criterion is 27.8°C (82.0°F) and the maximum is 29.4°C (85.0°F).

2022 Temperature Results – Datasondes

Temperature was monitored continuously over short periods of time (4-8 days) during low flow and high ambient temperature periods in August 2022 via the deployment of Datasondes at 9 locations in the lower Olentangy River mainstem (Figure 29). The results were judged against the average and maximum temperature criteria in the Ohio WQS that apply during June 16-September 15.. Median values were well below the summer average temperature criterion as were maximum values below the summer maximum temperature criterion. Median values ranged between 22-24°C and maximum values of 25-29°C reflecting the warmest period of ambient temperatures during the summer of 2022. Median and maximum temperatures generally increased in a downstream direction. None of these results suggest any water quality issues related to either the direct or indirect effects of temperature on aquatic life.

pH

pH is a measure of how acidic/basic water is with a measurement range of 0 to 14. It is a

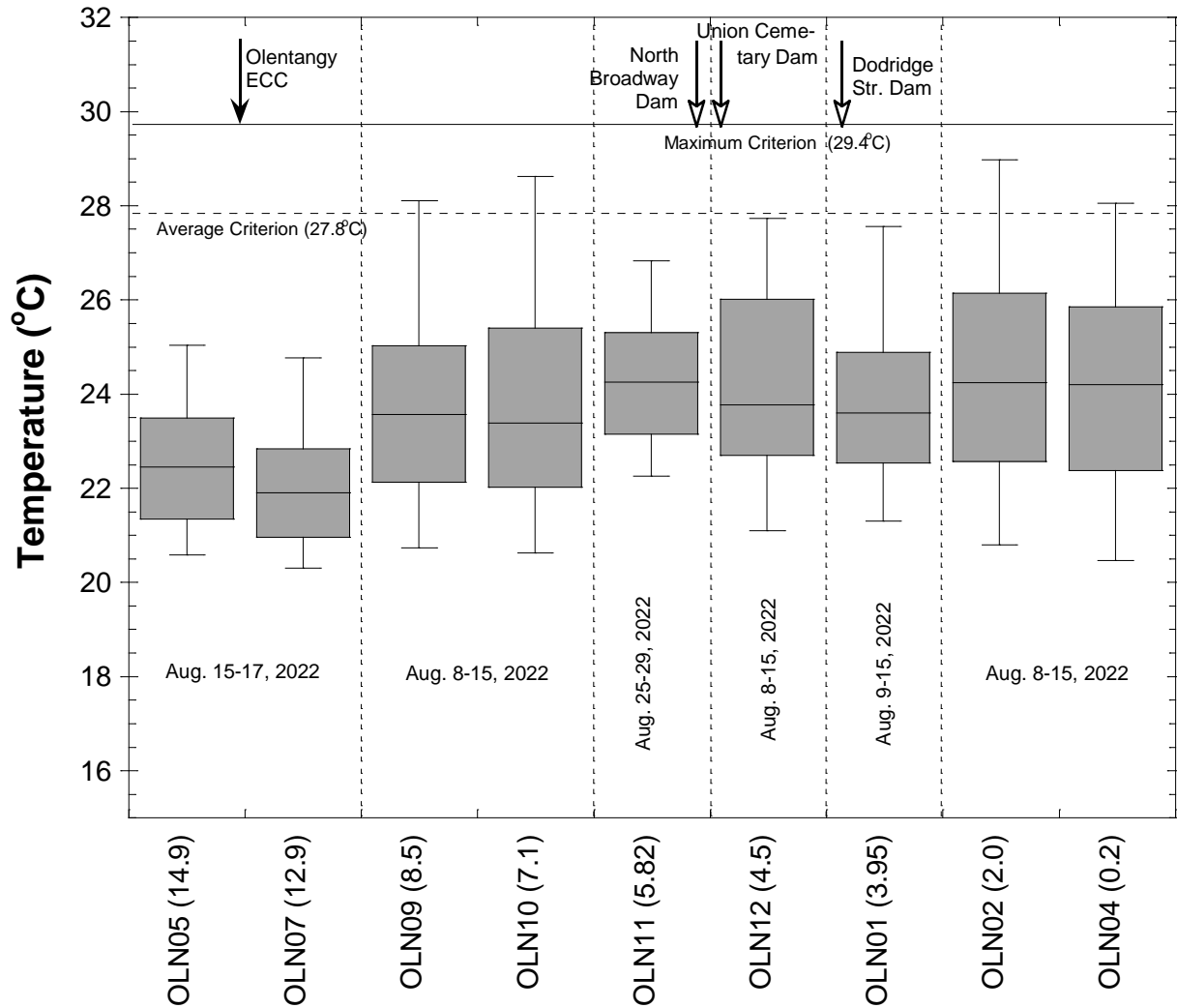


Figure 29. Temperature (°C) measured continuously by Datasondes deployed for a 4-8 day periods during August 8-15, 15-17, and 25-29 at nine (9) locations in the lower Olentangy River mainstem. Box-and-whisker plots show the minimum, maximum, 25th and 75th percentiles, median, and outlier (>2 interquartile ranges from the median) values. The applicable Ohio EPA summer average and maximum temperature criteria are shown by solid and dashed lines.

measure of the relative amount of free hydrogen (acidic) and hydroxyl (basic) ions in the water. pH is measured on a logarithmic scale where each number represents a 10-fold change in the acidity or basicness of the water. For example, water with a pH of five is 10 times more acidic than water having a pH of six. It is an important factor in how chemicals affect aquatic life and other biological processes. It determines the solubility (amount that can be dissolved in the water) and biological availability (amount that can be utilized by aquatic life) of chemical constituents such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals (lead, copper, cadmium, etc.). For example, pH affects the amount of total ammonia-N that is present in the unionized and toxic form and along with temperature is part of the water quality criterion. At a temperature of 25°C, which is typical of summer ambient temperatures in the study area, a change in pH from 8.5 S.U. to 9.0 S.U. changes the equivalent ammonia-N

criterion from 3.20 mg/L to 1.10 mg/L, a decrease of almost 66%. It also affects how much and what form of phosphorus is most abundant in the water, and therefore affects how aquatic plants and animals can utilize it. As a result pH is responsive to algal photosynthesis and respiration with a diel cycle of pH being higher in daytime and lower at night similar to D.O. Along with hardness it affects the degree to which heavy metals are soluble which determines their toxicity. Reference pH values for small rivers in the ECBP ecoregion range between a median value of 8.2 S.U. and a statistical maximum of 8.4 S.U. (Ohio EPA 1999a). The Ohio water quality criterion is expressed as a range of acceptable pH values between 6.5-9.0 S.U.

2022 pH Results – Datasondes

pH was monitored continuously during a 4-8 consecutive day periods of low flows and high ambient temperatures during August 2022 via the deployment of Datasonde units at nine (9) locations in the lower Olentangy River mainstem (Figure 30). Median values showed little

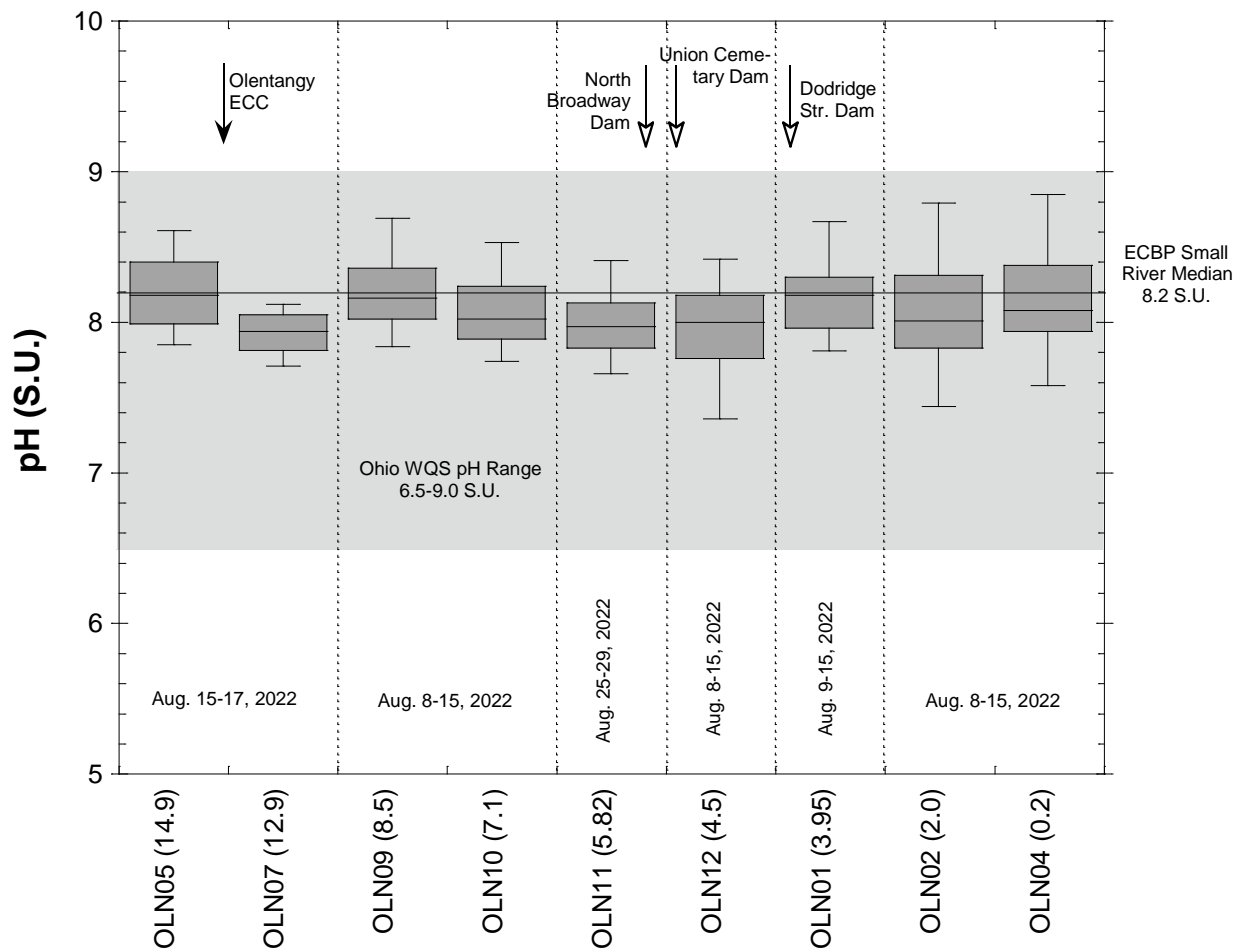


Figure 30. pH (S.U.) measured continuously by Datasondes deployed for a 4-8 day periods during August 8-15, 15-17, and 25-29 at nine (9) locations in the lower Olentangy River mainstem. Box-and-whisker plots show the minimum, maximum, 25th and 75th percentiles, median, and outlier (>2 interquartile ranges from the median) values. The applicable Ohio EPA summer average and maximum temperature criteria are shown by solid and dashed lines.

variation along the longitudinal continuum being within 0.3 S.U. between sites and a range of 7.9-8.2 S.U. Maximum pH values were in the vicinity of 8.1-8.8 S.U. with a general increase downstream. Both the median and maximum values were well within the range of the pH water quality criterion and at or slightly above the median regional reference value of 8.2 S.U. for small rivers in the ECBP ecoregion. None of these results suggest any water quality issues related to either the direct or indirect effects of pH on aquatic life and were well below values suggesting over enrichment by nutrients.

Dissolved Oxygen (D.O.)

Exceedances of dissolved oxygen (D.O.) were assessed with continuous data obtained from short term Datasonde deployments during August and a single long term site between mid-July and mid-September 2022. One of the primary purposes of the continuous D.O. monitoring was to support the combined analysis of the effects of nutrient enrichment following the current Ohio EPA approach for large rivers (Miltner 2018). It also provides the data necessary for more fully evaluating the results against the D.O. criteria in the Ohio WQS.

Short Term Continuous D.O. Results

Exceedances of dissolved oxygen (D.O.) were assessed with continuous data obtained from short term Datasonde deployments during August (Figure 31). One of the primary purposes of the continuous D.O. monitoring was to support the combined analysis of the effects of nutrient enrichment following the Ohio EPA approach for large rivers (Miltner 2018). It also provides the data necessary for more fully evaluating the results against the D.O. criteria in the Ohio WQS. In terms of compliance with the Ohio D.O. criteria no sites exceeded either the minimum or average D.O. criteria for the applicable aquatic life use in 2022. In terms of compliance with the Ohio D.O. criteria the median at all sites met and exceeded the applicable average D.O. criteria for the applicable EWH, WWH, and MWH uses, the former being applicable to the two sites upstream from I-270 which is the EWH/WWH boundary at RM 11.6. The minimum values at all sites also met the applicable minimum D.O. criteria. The lowest median and minimum D.O. values were recorded at OLN11 due presumably to the lower reaeration in the North Broadway dam pool. The 1.9 mile long reach of the Olentangy River between Adena Brook and the Dodridge Street Dam is designated Modified Warmwater Habitat (MWH) which has a lower D.O. criteria of 4.0 mg/L average and 3.0 mg/L minimum, which was met by the 2022 results. 2014. All median and minimum values met the WWH average and minimum D.O. criteria. Two sites OLN02 (RM 2.0) and OLN04 (RM 0.2) had maximum and outlier values of 14.5-18.0 mg/L that exceeded 14 mg/L which is an approximation of the 9 mg/L over enriched diel swing of Miltner (2018). These were the two downstream most sites and reflected the accumulation of nutrient effects from CSOs, SSOs and urban stormwater. The upstream most site at OLN05 (RM 14.90) had a maximum of 13.9 mg/L that exceeded the maximum of 12 mg/L that is an approximation of the 7 mg/L enriched diel swing. The mainstem downstream from the former Fifth Ave. Dam was designated WWH in 2022 between Tuttle Park (RM 3.9) and the former Fifth Avenue Dam (RM 1.9) that was removed in 2014.

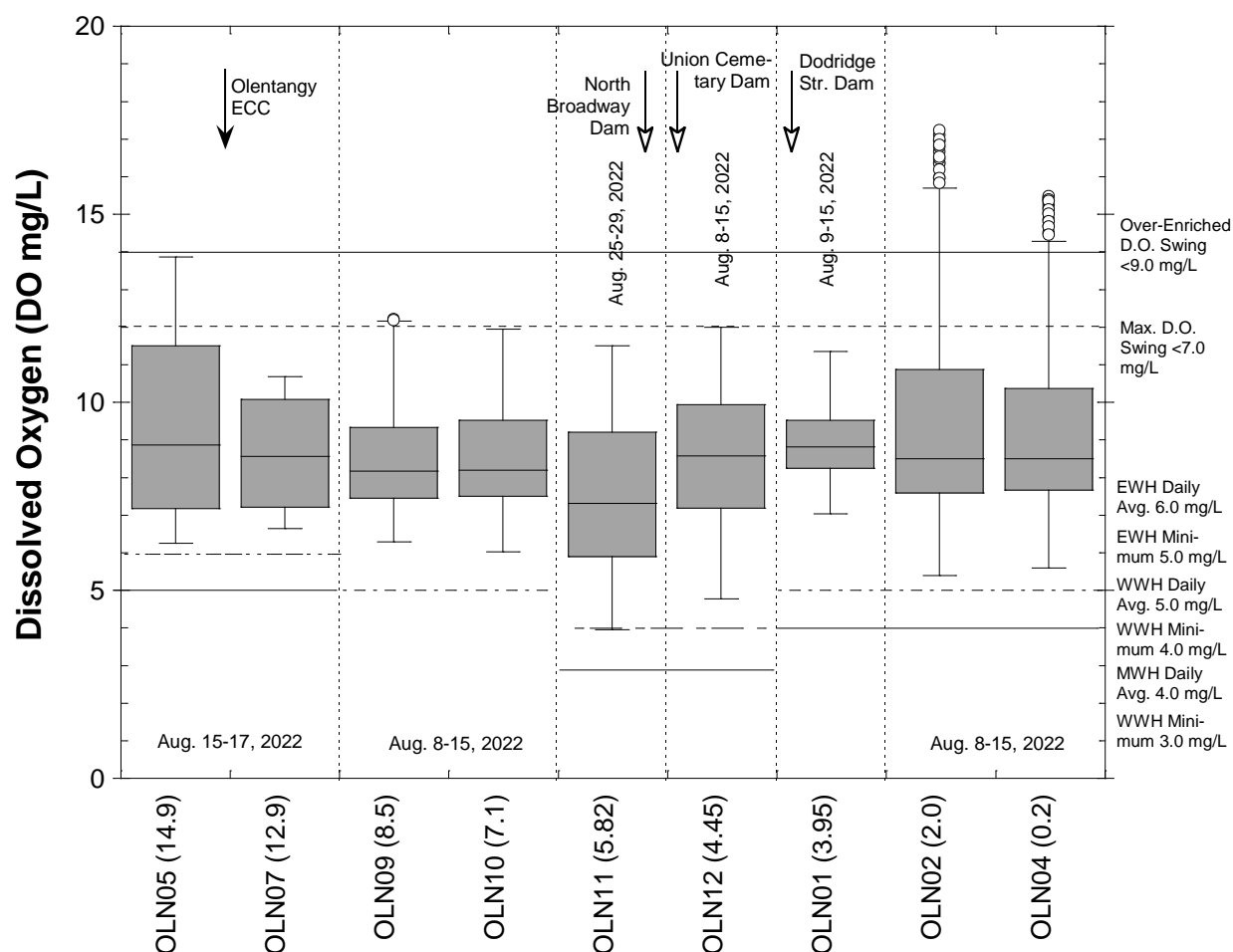


Figure 31. Dissolved oxygen (D.O.) measured continuously by Datasondes deployed for 4-8 day periods during August 2022 at nine (9) locations in the lower Olentangy River mainstem. Box-and-whisker plots show the minimum, maximum, 25th and 75th percentiles, median, and outlier (>2 interquartile ranges from the median) values. The applicable Ohio EPA minimum criteria for the EWH (5.0 mg/L), WWH (4.0 mg/L), and MWH (3.0 mg/L) uses are shown by solid lines. The daily average EWH (6.0 mg/L), WWH (5.0 mg/L), and MWH (4.0 mg/L) are shown by the hashed lines. The acceptable and maximum upper diel D.O swing boundaries are shown by dashed and solid lines. Discharges and significant dams are indicated along the top of the graphic.

Long Term Continuous D.O. Results

The long term results recorded between mid-July and mid-September at the OLN05 (RM 14.90) location over a period of 70 days showed the variation in the diel cycle and across the time interval during the summer period when lower flows and higher ambient temperatures would be expected to produce the minimum D.O values and also the widest diel swings (Figure 32). There were no exceedances of the WWH minimum or average D.O. criteria and 14 days where the maximum exceeded the enriched value of 12 and none exceeded the over enriched value of 14 mg/L. The highest exceedances overlapped the short term period of August 15-17 extending several days before and after.

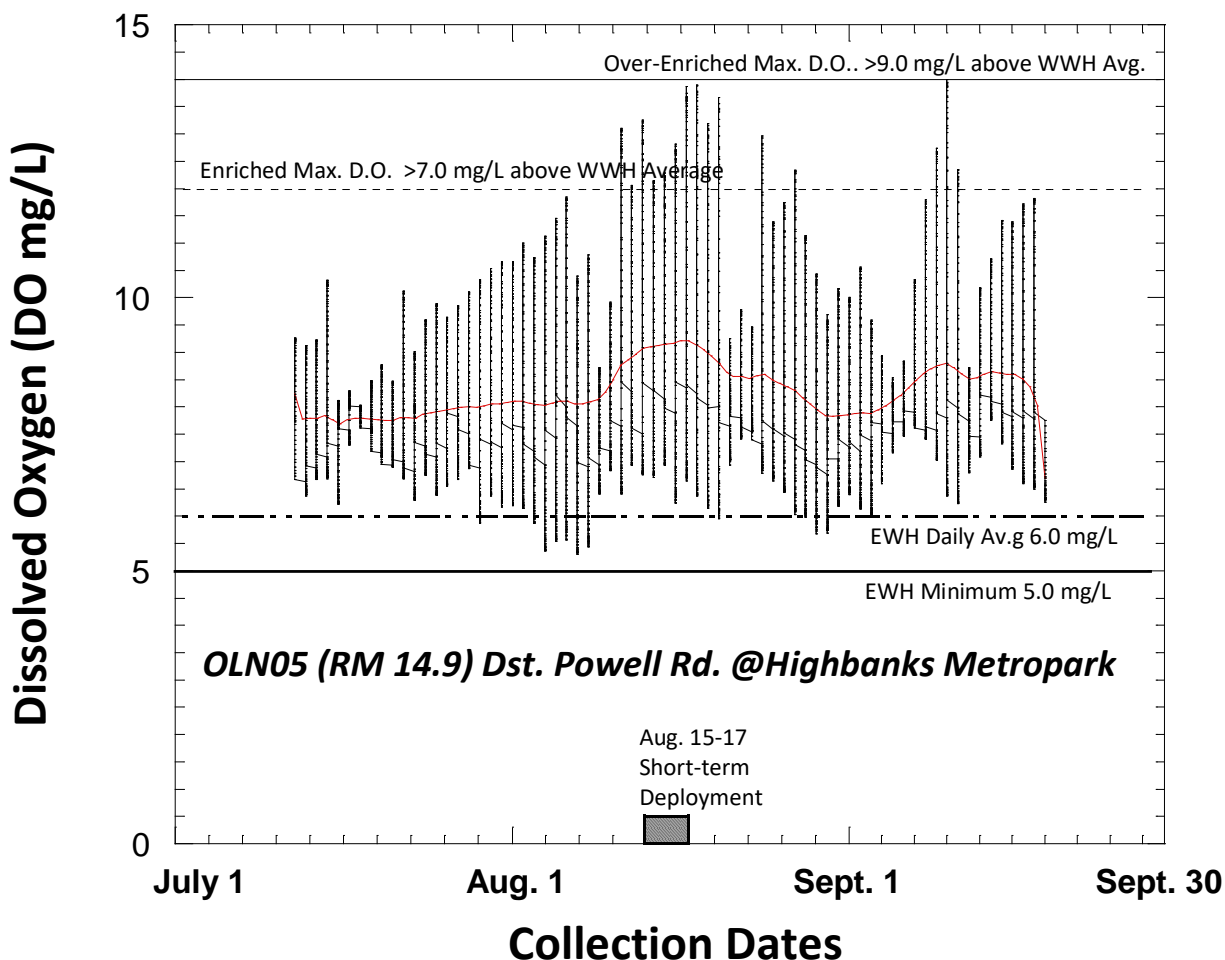


Figure 32. Daily maximum, minimum, and average D.O. recorded at the long term location in the Olentangy River mainstem during mid-July to mid-September 2022. The applicable EWH daily minimum and average criteria and the values indicative of enriched and over-enriched conditions are shown by dashed and solid lines. The term of the short term deployments are indicated along the collection dates.

An objective of the long term deployments was to determine how representative are the short term deployments used in the combined nutrients effects assessment against what happens over the comparative long term of the warmest and low flow months of July, August, and September. To accomplish this the number and duration of exceedances of the minimum and average D.O. criteria and the enriched and over enriched values of 12 and 14 mg/L (Table 23). The results generally show that the short term deployment was sufficient to capture exceedances of these thresholds and other D.O. related parameters used in the Ohio EPA Large river nutrient assessment. The analysis in Table 24 shows some differences in key D.O. thresholds between the short term and long term results at the same sites. The long term data had lower minimum and mean D.O. values, but similar maximum D.O. values. In terms of the duration of exceedances of the 12 mg/L and 14 mg/L maximum D.O. values indicative of enriched and over-enriched conditions the short term data amplified their frequency compared

Table 24. Summary of short term and long term D.O. results in July, August, and September 2022 at the long term deployment site in the Olentangy River mainstem. Results include the minimum, mean, and maximum D.O. and the duration of D.O. minimums less than the respective WWH and EWH criteria and the enriched and over enriched values of 12 and 14 mg/L.

Site ID	River Mile	Days	Hours	Earliest Date	Latest Date	Long-term Interval Summary Statistics							
						Min. DO (mg/L)	Mean DO (mg/L)	Max. DO (mg/L)	% Hours <4 mg/L	% Hours <5 mg/L	% Hours <6 mg/L	% Hours Max >12 mg/L	% Hours Max >14 mg/L
OLN05	14.90	70	1643	12-Jul-22	19-Sep-22	5.3	8.3	14.0	0.0	0.0	2.8	3.7	0.0
				Earliest Date	Latest Date	Short-term Interval Summary Statistics							
						Min. DO (mg/L)	Mean DO (mg/L)	Max. DO (mg/L)	% Hours <4 mg/L	% Hours <5 mg/L	% Hours <6 mg/L	% Hours Max >12 mg/L	% Hours Max >14 mg/L
OLN05	14.90	3	72	15-Aug-22	17-Aug-22	6.3	9.4	13.9	0.0	0.0	0.0	19.1	0.0

to the long term results that included numerous days with lower minimum, median, and maximum values. A key question is about the actual effect of short term exceedances vs. the long term results which will inherently include less stressful periods due to the potential “relief” effects of periods without exceedances. A concept similar to the stress/recovery for temperature developed by Bevelhimer and Bennet (20007) would be worth exploring for application to the duration of D.O. exceedances.

Ammonia-Nitrogen (N)

The Ohio water quality criteria are expressed as total ammonia-N with pH and temperature being the key variables used to determine how the total corresponds to the toxic unionized fraction. For the analysis of compliance with the Ohio water quality criteria, a series of combinations of pH and temperature values measured by grab samples and the continuous Datasonde data were derived in the 2020 report (MBI 2022). The analysis of the resulting total ammonia-N criteria values applicable to the Scioto River mainstem were based on river reach-specific 75th percentile temperature and pH values per the Ohio WQS Implementation Rules (OAC 3745-2). The ammonia-N criterion for the WWH use designation in the three mainstem reaches varied between 0.50-0.60 mg/L as total ammonia-N and was 0.50 mg/L for the EWH reach of the Olentangy River mainstem. Based on the U.S. EPA (2013) criteria the resulting total ammonia-N was between 0.32-0.34 mg/L for all mainstem reaches. The latter represents a roughly 50% reduction in allowable total ammonia-N compared to the Ohio WWH and somewhat less for EWH. The resulting total ammonia-N criterion is sensitive to elevated temperature and pH especially, hence the analysis was extrapolated to a highly elevated pH (9.0 S.U.) and temperature (30°C) that might be expected under climate driven changes to summer low flows and elevated nutrient levels. Such changes would act to prolong elevated ambient temperatures and pH levels via more frequently occurring low flows and excessive algal activity stimulated by elevated nutrients fostering high pH values. Even at these elevated temperature and pH values the resulting U.S. EPA (2013) total ammonia-N would be 0.080 mg/L or a 7.5 times decrease in allowable total ammonia-N.

2022 Ammonia-N Results

Mean concentrations of ammonia-N in the lower Olentangy River mainstem during 2022 were at or below the 0.014 mg/L method detection limit (MDL) at five (5) sites and above it at the remaining six (6) sites (Table 25). Elevated mean and maximum values occurred downstream from the ECC discharge with the mean at 0.202 mg/L which was the second highest mean value in the entire Olentangy River study area in 2022 and slightly lower than in 2020. The mean at this and all other sites were well below both the Ohio EWH and WWH criterion and the U.S. EPA (2013) criterion for the design pH and temperatures established in 2020 (MBI 2022), with four (4) values above the small river regional reference mean of 0.065 mg/L. After peaking downstream from the ECC discharge, ammonia-N levels dropped sharply at the next site three (3) sites downstream. Means increased at OLN11 (RM 5.82) and OLN12 (RM 4.5) with the latter having the highest mean of 0.482 mg/L in 2022. Another elevated value occurred at OLN03 (RM 1.50) with all other sites downstream from Dodridge Dam at the MDL of 0.014 mg/L. Mean

Table 25. Mean values for demand and nutrient related parameters in the lower Olentangy River mainstem in 2020 and 2022. Bold italic values are the highest between the two years. Values are color coded in accordance with the legend at the bottom.

Site ID	River Mile	Drainage Area (mi. ²)	Ammonia- Nitrogen as Ammonia mg/L (Mean)		BOD 5 Day mg/L (Mean)		Kjeldahl- Nitrogen, Total as N mg/L (Mean)		Nitrate mg/L (Mean)		Nitrite mg/L		Phosphorus Total as P mg/L		Phosphorus, Dissolved Orthophosphate mg/L		TSS (Total Suspended Solids) mg/L	
			2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022
<i>Olentangy River</i>																		
OLN05	14.9	482	0.028	0.014	1.78	1.76	0.73	0.81	1.42	1.23	0.03	0.01	0.085	0.240	0.09	0.10	6	12
OLN07	13.1	489	0.211	0.202	2.48	1.98	1.11	1.23	2.43	1.88	0.12	0.09	0.152	0.240	0.12	0.10	4	12
OLN08	12.0	490	0.024	0.092	1.85	1.58	0.76	0.72	1.60	1.57	0.03	0.02	0.116	0.240	0.10	0.11	6	12
OLN09	8.5	510	0.034	0.021	1.60	2.40	0.70	0.69	1.33	1.35	0.01	0.01	0.099	0.240	0.10	0.10	13	12
OLN10	6.8	516	0.027	0.014	1.63	2.06	0.66	0.66	1.26	1.25	0.03	0.01	0.126	0.240	0.09	0.10	6	12
OLN11	5.5	524	0.025	0.073	1.63	2.02	0.68	0.76	1.27	1.31	0.03	0.01	0.080	0.248	0.10	0.10	12	12
OLN12	4.5	529	0.021	0.428	1.83	1.82	0.64	1.03	1.25	2.60	0.03	0.01	0.126	0.900	0.09	0.10	14	12
OLN01	3.9	531	0.020	0.014	1.70	2.43	0.64	0.78	1.26	1.25	0.03	0.01	0.095	0.240	0.09	0.09	10	12
OLN02	2.0	537	0.020	0.014	1.98	2.33	0.60	0.74	1.19	1.10	0.03	0.01	0.088	0.240	0.08	0.08	9	13
OLN03	1.5	537	0.020	0.090	1.92	2.43	0.71	0.72	1.20	1.23	0.03	0.01	0.102	0.240	0.08	0.07	10	12
OLN04	0.3	543	0.014	0.014	2.18	2.43	0.65	0.68	1.17	1.09	0.03	0.01	0.077	0.240	0.07	0.07	6	12
Large River Narrative Threshold Rankings	<50th Percentile		≤0.025		≤2.50 ^a		≤0.60		≤1.65		≤0.02		≤0.15		≤0.15 ^d		≤28	
	<75th Percentile		≤0.045		≤3.90 ^b		≤0.80		≤3.06		≤0.03		≤0.24		≤0.30 ^d		≤41	
	<90th Percentile		≤0.074		≤5.50 ^c		≤1.10		≤4.93		≤0.04		≤0.37		>0.30 ^d		≤62	
	<95th Percentile		≤0.139				≤1.40		≤7.67		≤0.07		≤0.55				≤85	
	>95th Percentile		>0.139				>1.40		>7.67		>0.07		>0.55				<85	
Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		^a Miltner (2018); ^b Ohio EPA 1999, Median; 2IQR>Median		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		

values were higher in 2022 than in 2020 at four (4) sites two of which are downstream from Adena Brook in the North Broadway and Dodridge Dam impoundments.

Five-Day Biochemical Oxygen Demand (BOD₅)

Biochemical oxygen demand (BOD) measures the amount of oxygen consumption in mg O₂/L by the aerobic oxidation and consumption of organic matter primarily by bacteria. The higher the BOD the more rapidly is D.O. depleted in the water. The principal sources of BOD in rivers and streams are organic matter including sewage, industrial wastes containing organic matter, leaves, soils high in organic matter, woody debris, and dead and decaying algae. Reducing the oxygen demanding properties of municipal wastewater has been a longer term objective for wastewater treatment than has reductions in ammonia-N. Expressed here as the five-day biochemical oxygen demand (BOD₅), this parameter, too, has reflected the effectiveness of wastewater treatment at WWTPs throughout Ohio and the U.S. BOD was originally expressed as total BOD which included both nitrogenous and carbonaceous properties of sewage effluent. As the nitrogenous fraction was addressed by improved nitrification, the measurement changed to carbonaceous or cBOD for measuring treatment effectiveness and reporting compliance. In this analysis the generic BOD₅ expression is used while recognizing that post-two stage nitrification values are comprised almost entirely of the carbonaceous fraction. While elevated BOD can reflect excessive inputs by point sources, the widespread control of this parameter by water quality based permitting and subsequent wastewater treatment has greatly reduced it as a major water quality concern. Instead, elevated BOD is now more likely a result of nonpoint source inputs and the indirect effects of flow and habitat alteration that exacerbate the adverse effects of algal dynamics spurred by excessive nutrient enrichment. As a result this is a key parameter in the Ohio large rivers nutrient assessment (Miltner 2018).

2022 BOD₅ Results

Mean BOD₅ levels in the lower Olentangy mainstem in 2020 and 2022 were similar mostly below the 2.50 mg/L “acceptable” level of Miltner with the site downstream from the ECC discharge at that level (Table 25). Most of the median values were in the 1.6-2.4 mg/L range. No mean values exceeded the 2.5 mg/L acceptable threshold and all were below the small rivers regional reference statistical maximum of 3.35 mg/L. The longitudinal trend in 2020 showed a small increase downstream from the ECC discharge and another slight increase in the Dodridge Street Dam impoundment that was followed by a comparatively sharp decline downstream from the dam. In 2022 the increase started at OLN09 (RM 8.50) and lasted through the remainder of the mainstem. None of these values suggest any form of significant or consequential organic enrichment.

Total Kjeldahl Nitrogen (TKN)

Total organic nitrogen as measured by Total Kjeldahl Nitrogen (TKN), an indicator of the living or recently dead fraction of sestonic algae, can be an indicator of organic enrichment. While TKN is not a direct effect parameter, it is indicative of the effects of organic enrichment by nitrogenous biomass. It has proven to be an effective indicator of excessive organic enrichment in runoff from urban and suburban nonpoint sources. Miltner (2018) recognized TKN as a

“stand alone” indicator of organic enrichment alongside BOD. In terms of assessment thresholds, Miltner (2018) considered a TKN value of ≥ 0.75 mg/L to be indicative of over enriched conditions. MBI (2015) in a regional analysis of Southwest Ohio rivers and streams derived a TKN threshold of 1.05 mg/L for WWH and 0.30 for EWH boatable sites. Regional reference levels derived by Ohio EPA (1999a) for large rivers in the ECBP ecoregion include a median of 0.90 mg/L and a statistical maximum of 1.50 mg/L.

2022 TKN Results

Mean concentrations of TKN in the lower Olentangy River mainstem during 2020 and 2022 were remarkably similar along the mainstem generally ranging between 0.60-0.80 mg/L with the exception of values 1.10 mg/L downstream from the ECC discharge (Table 25) and a mean value of 1.03 at OLN12 (RM 4.50) in the Dodridge Dam impoundment. The mean at these sites exceeded the Miltner (2018) over-enriched value of 0.75 mg/L and the 90th percentile small rivers regional reference value. The remaining median values were all less than the over-enriched threshold, but with only one exception were above the small rivers regional reference median of 0.60 mg/L. The longitudinal pattern closely resembled that for BOD₅ and for which TKN can serve as a proxy in the Ohio large river nutrient assessment (Miltner 2018).

Nitrate-Nitrogen (NO₃-N)

Nitrate as nitrogen is generally expressed as nitrate-N and along with nitrite-N comprises dissolved inorganic nitrogen in water. The mean and maximum values reported herein are nitrate-N plus nitrite-N, the latter of which was detected at low levels and in only about 10% of the samples collected in the mainstem. Nitrates are not toxic to aquatic life under even elevated concentrations, are a primary and essential plant nutrient, and can contribute to water quality problems in excessive amounts. Together with the other primary nutrient phosphorus, nitrates in excess amounts can stimulate excessive algal production leading to adverse effects to the D.O. regime that in turn can adversely affect aquatic life. High nitrates in drinking water supplies can also pose a threat to human health. Sources of nitrates in the lower Olentangy River mainstem include agriculture and urban runoff and municipal wastewater resulting from the conversion of ammonia-N as part of the nitrification treatment process primarily at the ECC, but also upstream sources in Delaware. Assessment thresholds for nitrate-N are available as regional reference values of 1.65 mg/L (median) and 4.48 mg/L (statistical maximum) for small rivers in the ECBP ecoregion (Ohio EPA 1999a) and TMDL targets of 2.00 mg/L for WWH and 1.50 mg/L for EWH (Ohio EPA 1999a). The 1.50 mg/L threshold defined by Miltner (2018) as a “starting point” for managing nutrient related effects is close the regional reference median.

2022 Nitrate-N Results

Mean nitrate-N values were consistently less than the small rivers regional reference median threshold of 1.65 mg/L at all except the site downstream from the ECC discharge in 2020 and 2022 (Table 25) and a mean value of 2.60 at OLN12 (RM 4.50) in the Dodridge Dam impoundment. After these brief increases nitrate-N levels decreased slowly, but consistently

through the remainder of the mainstem. None of these results suggest any nutrient issues with this parameter in the lower mainstem.

Mean nitrite-N values were low except for values in 2020 and 2022 downstream from the ECC discharge that exceeded the 95th percentile regional reference value of 0.07 mg/L (Table 25). Nitrite-N usually dissipates to less than the MDL under ambient conditions which is reflected in both the 2020 and 2022 results.

Total Phosphorus (P)

Phosphorus (P) is both an essential and limiting nutrient for plant growth and animal life. It is the most limiting nutrient in freshwater systems primarily to algal growth and biomass. Elevated levels of phosphorus under certain conditions can result in excessive algal growth and activity that in turn affects the D.O. regime and consequently aquatic life. Elevated levels can also stimulate the production of toxic algae that can impact human health, recreation, and public water supplies. In flowing water bodies such as rivers and streams the adverse impacts of elevated P are indirect via how it impacts algal activity and ultimately the D.O. regime. Algal photosynthesis produces oxygen during daylight while algal respiration uses oxygen at night. The difference between daytime and nighttime D.O. values is termed the diel swing the width of which is indicative of nutrient stimulated algal activity. This cycle also impacts pH (high daytime, low nighttime values) which in turn can impact the toxicity of ammonia especially at higher pH levels (i.e., >8.0). Thus the management of P loads from both point and nonpoint sources is an emerging water quality management issue. Sources of phosphorus in the lower Olentangy River mainstem primarily include agricultural and urban runoff and municipal wastewater primarily from the Olentangy ECC, but also upstream from Delaware. The dynamics of how water quality and biological condition are affected by each is complex and related to physical factors such as flow (including retention time), habitat, and temperature (Ohio EPA 1999a; Miltner 2018). Assessment thresholds for total P are available as regional reference values of 0.330 mg/L (median) and 1.500 mg/L (statistical maximum) for small rivers in the ECBP ecoregion (Ohio EPA 1999a), TMDL targets 0.300 mg/L for WWH and 0.150 mg/L for EWH, and 0.130 mg/L defined by Miltner (2018) as the threshold for over-enrichment.

2022 Total P Results

Mean total P values in 2022 were just below the Miltner (2018) 0.130 mg/L and Ohio EWH 0.150 mg/L thresholds in the upper study area and then intermittently increasing to just above those thresholds downstream from Henderson Rd. (OLN10, RM 7.00; Table 25). There was no distinct longitudinal pattern that coincided with any specific sources of total P. The low range of the values did not indicate any appreciable evidence of nutrient enrichment. The 2022 results were difficult to compare to 2020 due the higher MDL of 0.240 mg/L. Still, highly elevated mean values occurred at OLN11 (RM 5.82) and OLN12 (RM 4.5), respectively, with the latter having the highest mean of 0.900 mg/L in 2022 indicated a significant input of total P relative to 2020 (Table 24). The orthophosphate results showed little variation and where it could be determined were a fraction of the total P results (Table 25).

Total Suspended Solids (TSS)

Total suspended solids (TSS) are particles that are larger than 2 microns that occur in the water column. Anything that can pass through a 2 micron average filter size is considered a dissolved solid. TSS can include any particles drifting in the water column to include inorganic sediment, silt, and sand and organic matter such as plankton and algae. At typical ambient concentrations TSS has little or no direct effect on aquatic life. However, extremely high concentrations can be harmful to fish and invertebrates by clogging gills and embedding substrates. It is easy to measure and thus it is commonly employed as a singular indicator of nonpoint source pollution (MS4 stormwater permitting) despite its inherent variability and serious shortcomings as a reliable standalone indicator of impairment. Miltner (2018) included it as a large river nutrient effects parameter, but in a restricted role as a screening proxy parameter with >25 mg/L indicating enriched conditions when other indicators such as BOD₅ and TKN are not available.

2022 TSS Results

Mean TSS values exhibited no meaningful longitudinal pattern as all values were very low being below the median regional reference values for small rivers in the ECBP ecoregion (Table 25). Mean values ranged between 4-14 mg/L which are well below the Miltner (2018) screening level of 25 mg/L and the small river regional reference median of 28 mg/L. The pattern was erratic with no apparent relationship to a source or sources including dams and tributaries. The lowest mean of 4 mg/L was observed downstream from the ECC discharge in 2020 that represented a decline from the upstream location. TSS can reflect suspended inorganic and organic particles of which there are ample sources of each in the lower mainstem. However, given that samples were purposely collected under relatively stable summer normal flow conditions the contribution of inorganic particles is likely higher than at elevated flows and episodes of runoff.

Nutrient Effects Assessment

The impact of nutrients on aquatic life has been well documented (Allan 2004), but the derivation of modernized nutrient criteria and their form and application are only just now emerging. Because of the widely varying efforts to develop nutrient criteria by the States, conflicting U.S. EPA oversight, and the potential cost of additional nutrient controls it has been a controversial issue (Evans-White et al. 2014). Unlike toxicants, the influence of nutrients on aquatic life is indirect and primarily via their influence on algal photosynthesis and respiration and the resulting increase in the magnitude of diel D.O. swings and by the biochemical oxygen demand exerted by algal photosynthesis, respiration, and decomposition. Nutrients can also affect food sources for macroinvertebrates and fish and the response of aquatic life to elevated nutrients is co-influenced by habitat (e.g., substrate composition, channel morphology), stream flow (e.g., scouring and dilution), temperature, and exposure of the water column to sunlight. Ohio has developed a technical approach to evaluate nutrient effects in large rivers (Miltner 2018) and is in the midst of a process to develop modernized nutrient water quality criteria. At this time an approach for developing nutrient water quality criteria for large rivers was described as part of an Early Stakeholder Outreach process in 2018 (Ohio EPA 2018) to revise

(OAC 3745-1-36¹⁴). However, no formal proposal for revising these criteria has been made at this time.

The Ohio large rivers approach described by Miltner (2018) offers assessment thresholds for each of the variables included in a combined nutrients effect assessment for three states of eutrophication – acceptable, enriched, and over-enriched (see Table 12). The enriched and over-enriched states also imply that biological assemblages are “stressed” for enriched and impaired for over-enriched along with the over-enriched state being “aesthetically obvious”. For the latter, the Ohio EPA (2018) ESO presentation showed visual signs of over-enrichment based on color and water clarity with enriched conditions at >100 µg/L sestonic chlorophyll a and nuisance conditions occurring at levels of >165 µg/L. The combined effects of nutrient enrichment were assessed to integrate the preceding descriptions of the concentrations of each of the key nutrient related parameters with measures of algal productivity, habitat, and the numeric biocriteria. A multi-parameter approach using elements of the Ohio large rivers methodology (Miltner 2018), the proposed eutrophication standard box model (Ohio EPA 2018), the Ohio EPA SNAP (2015b) methodology, and the primacy of the biocriteria for determining aquatic life use attainment status (OAC 3745-1-07[C]). These were used in a combined approach to evaluate nutrient effects on the eutrophication status and aquatic life use attainment in the lower Olentangy River mainstem.

The results are detailed in a matrix that shows the biocriteria indices, the QHEI score, benthic and sestonic chlorophyll a (as biomass), the maximum and minimum D.O. (based on Datasondes), the width of the highest daily diel D.O. swing, BOD₅, total P, TKN, TSS, nitrate-N, and an overall rating of the degree of nutrient enrichment based on the frequency and magnitude of exceedances of thresholds for the aforementioned indicators and parameters with aquatic life use attainment status as the controlling factor. Although the longitudinal and temporal trends in the chemical indicators and their relationship to the nutrient enrichment thresholds described by Miltner (2018) has already been thoroughly described on an individual parameter basis, the box model matrix allows for an aggregate assessment of the contributing variables along the longitudinal pollution gradients present in the lower Olentangy River. The overall degree of nutrient enrichment effects are represented by three narrative ratings of acceptable, enriched, or over enriched contingent on the degree to which each of the parameters and indicators exceeded their respective thresholds in accordance with Miltner (2018) against the attainment status of the applicable aquatic life use designation. Full attainment of the applicable aquatic life use resulted in an acceptable rating in keeping with OAC 3745-1-07(C)(1).

All of the nine (9) lower Olentangy River mainstem sites that were evaluated had an acceptable result even though three (4) sites were in partial attainment of the currently assigned aquatic life use due to causes other than nutrient enrichment (Table 26). Some of the primary nutrient enrichment effect indicators such as the diel D.O. swing, maximum D.O., TKN, and total P and nitrate-N exceeded the acceptable levels of Miltner (2018) or the Ohio EPA (2015b) Stream

¹⁴ OAC 3745-1-36 is not currently listed in the Ohio WQS and will be proposed as a new rule.

Table 26. Results of applying Ohio large river nutrient assessment and box model to nine (9) sites in the 2022 lower Olentangy River study area. Thresholds for how each parameter reflects the degree of nutrient enrichment effects and are at the bottom of the matrix.

Site id	River Mile (Fish/Macros)	Drainage Area (sq mi)	Current Aquatic Life Use ^a	IBI ^b	Miwb ^b	ICI ^b	Aquatic Life Use Status ^c	QHEI	Benthic Chlorophyll (mg/m ²)	Sestonic Chlorophyll-a (ug/L)	BOD (mg/L)	Min. DO (mg/L)	Max. DO (mg/L)	DO Swing (mg/L)	TKN (mg/L)	TSS (mg/L)	Total P (mg/L) ^d	Nitrate (mg/L)	Overall Nutrient Box Model Status
Olentangy River - EWH (Existing)																			
OLN05	14.90/14.90	482	EWH	48	9.9	E	Full	78.0	31.8	13.4	1.76	5.3	14.0	7.7	0.81	12.0	0.24	1.23	Acceptable
OLN07	12.90/13.30	489	EWH	46 ^{ns}	8.9 ^{ns}	46	Partial	76.5	15.2	9.4	1.98	6.6	10.7	3.9	1.23	16.8	0.24	1.88	Acceptable
Olentangy River - WWH (Existing)																			
OLN09	8.50/8.50	510	WWH	50	9.3	34 ^{ns}	Full	82.5	34.6	1.8	2.40	6.3	12.2	5.0	0.69	15.0	0.24	1.35	Acceptable
OLN10	7.10/7.00	516	WWH	50	9.4	38	Full	82.5	26.9	5.6	2.06	6.0	12.0	4.6	0.66	13.3	0.24	1.25	Acceptable
Olentangy River - MWH-Impounded (Existing)																			
OLN11	5.82/5.50	524	MWH-I	32	7.3	20*	Partial	54.5	22.4	5.9	2.02	4.0	11.5	7.3	0.76	14.7	0.25	1.31	Acceptable
OLN12	4.45/4.50	529	MWH-I	38	7.9	20*	Partial	58.0	53.5	7.5	1.82	4.8	12.0	4.6	1.03	14.3	0.90	2.60	Acceptable
Olentangy River - WWH (Existing)																			
OLN01	3.95/3.90	531	WWH	48	10.2	VG	Full	78.8	19.1	7.7	2.43	7.0	11.4	3.0	0.78	14.0	0.24	1.25	Acceptable
OLN02	2.00/2.00	537	WWH	48	9.9	42	Full	75.0	20.5	4.5	2.33	5.4	17.2	9.2	0.74	19.0	0.24	1.10	Acceptable
OLN04	0.20/0.20	543	WWH	52	8.9	42	Full	78.5	22.3	4.2	2.43	5.6	15.5	7.7	0.68	13.2	0.24	1.09	Acceptable
Narrative Threshold Rankings	Exceptional			44-60	>9.1	≥42	FULL	>75											
	Good			38-43	8.0-9.1	32-40	FULL	60-74	<182	<30	<2.5	>4	<12	<7.0	<0.75	<20	≤0.13	<1.56	Acceptable
	Fair			26-37	5.8-7.9	14-30	PART./NON	46-59	182-320	30-100	2.5-5.9	<4	>12	7.0 - 8.9	≥0.75	>20	>0.13	≥1.56	Enriched
	Poor			19-25	4.0-5.7	8-12	NON-Poor	30-45	>320	>100	>6.0	<2	>15	>9.0	≥1.00				
Very Poor			12-18	<4.0	0-6	NON-V.Poor	<30												
Footnote:	a - as codified in OAC 3745-1-07, Table 7-1; b - Nonsignificant departure of 4 units for IBI and ICI, 0.5 Miwb units allowed for attainment; c - FULL - all biocriteria attain; PARTIAL - one or two biocriteria fail to attain; NON - no biocriteria attain or one assemblage with poor or very poor narrative. d - total P values at the MDL of 0.24 were assumed to be below the acceptable threshold.																		

Nutrient Assessment Procedure (SNAP). Of the allied chemical parameters only TKN at the two sites downstream from the ECC discharge signaled over-enrichment. At the same two sites, total P just barely exceeded the enriched threshold at the site downstream from the ECC and nitrate-N exceeded the enriched threshold at both sites. The pattern for TKN, total P, and nitrate-N indicate the ECC as the primary source, but the lack of responses in the other nutrient effect indicators show that there is little if any effect from nutrient enrichment in the 2022 results similar to what was observed in 2020. Sites in full attainment of WWH and performing at very good and exceptional levels in the lower four (4) miles of the mainstem had the highest maximum D.O. values and the highest diel swings. There was some evidence of slight effects on the D.O. regime in the North Broadway and Dodridge Street impoundments, a pattern that was also evident in the Scioto mainstem in downtown Columbus where the combination of flow and habitat alterations were the most prevalent.

Urban Parameters

Urban parameters include the common ions chloride and sulfate, conductivity, total dissolved solids, and common heavy metals such as copper, lead, and zinc. Total suspended solids can be also be included in this group because of its widespread use as an indicator of urban runoff and stormwater. These parameters can become highly elevated in urbanized watersheds and are indicative of diverse sources and activities that exemplify urban land uses. Grab temperature and pH were also included since they straddle the conventional and urban parameters.

Chlorides

In temperate climates such as exists in central Ohio, dissolved materials in the form of chlorides are an emerging issue because they accumulate in soils and shallow groundwater and have been documented to reach concentrations that can threaten and impair aquatic life. Of particular concern in urban areas with high road density is the concentration of chlorides from winter road salt applications and point source loadings from water treatment blowdown. Chlorides have been documented to be increasing steadily in freshwaters including large rivers (Mullaney et al. 2009; Kelly et al. 2012). Chlorides do not exhibit a simple runoff and export mode of effect, but rather accumulate in near surface groundwater (Kelly 2008), soils, and land surfaces adjacent to streams. Seasonal studies have shown that elevated summer concentrations are correlated with higher and acute concentrations during late winter and spring periods (Kaushal et al. 2005). Research in New England (Kaushal et al. 2005) and Minnesota (Novotny et al. 2008) show that chlorides can accumulate in watersheds and that there is a strong association between high winter and elevated summer concentrations. Novotny et al. (2008) identified that 78% of the road salt applied in a Minnesota watershed accumulated in a given year and contributed to an increase in summer chloride concentrations. Ohio does not have a chloride water quality criterion for aquatic life, although there is a maximum contaminant level of 250 mg/L that applies to public water supplies. U.S. EPA (1988) recommends a water quality criterion of 230 mg/L for the protection of aquatic life. A more recent Ohio study that examined several decades of ambient water quality data against biological assemblage response (Miltner 2021) recommends a “safe” level for chloride at 52 mg/L for the protection of high quality waters. This value is in line with derived values of 68.4

mg/L for WWH and 32.9 mg/L for EWH attainment at boatable sites in Southwest Ohio (MBI 2015).

2022 Chloride Results

Mean chloride values in the lower Olentangy mainstem increased from a low of 40 mg/L at the upstream most site (OLN05, RM 14.40) to a value of 71.7 mg/L downstream from the ECC discharge, both in 2020 and 2022 (Table 27) and suggesting the ECC as a net source of chloride loadings during summer-fall low flow periods. In 2022 mean chloride levels ranged from 48.5 mg/L at OLN05 (RM 14.90) to 71.7 mg/L at the mouth (OLN04, RM 0.30) with an overall upstream to downstream increase. All of the means exceeded the 75th percentile reference value for small rivers in the ECBP ecoregion and most were above the Miltner (2021) hazard level of 52 mg/L. The 2022 means were overall slightly higher than in 2020.

Total Dissolved Solids

Total dissolved solids (TDS) is a measure of the dissolved content of all inorganic and organic substances present in water consisting of solids small enough to pass through 2-micron filter. While TDS is not generally considered to be a pollutant it can be useful as an aggregate indicator of the presence of a broad array of chemical pollutants. Common nonpoint sources of TDS in receiving waters are agricultural and urban runoff with parent geology and soils being important co-factors. Point sources of both industrial and municipal wastewater also influence TDS levels. The most common chemical constituents are calcium, phosphates, nitrates, sodium, potassium, and chloride, each of which can emanate from the aforementioned nonpoint and point sources. Total dissolved solids are differentiated from total suspended solids (TSS), in that the latter cannot pass through a 2 micron filter and are indefinitely suspended in solution. The Ohio TDS water quality criterion is 1500 mg/L. Regional reference values for small rivers in the ECBP are a median of 460 mg/L and a statistical maximum of 520 mg/L.

2022 TDS Results

Mean TDS values exhibited a more variable longitudinal pattern than total chloride with a low value of 400 mg/L at the upstream most site (OLN05, RM 14.40) and a high value of 422 mg/L at OLN09 (RM 8.50; Table 27). All of the mean TDS values were below the regional reference median of 460 mg/L for small rivers in the ECBP ecoregion. The highest value of 422 mg/L is less than one-third the current Ohio water quality criterion of 1500 mg/L. The 2022 means were generally higher by 20-70 mg/L in 2022 compared to 2020.

Specific Conductance

Specific Conductance is a measure of how effectively water conducts an electrical current. Conductance increases with an increasing amount and mobility of ions and is correlated with the dissolved solids content of water. The ions conduct electricity because they are negatively or positively charged when dissolved in water. As such conductance is an indirect measure of the concentration of dissolved ions in solution and is defined as the electrical conductance of one cubic centimeter (cm³) of a solution at 25°C. The Ohio WQS have a conductance “criterion” of 2400 µS/cm that is equivalent to the TDS criterion of 1500 mg/L. Regional reference

Table 27. Mean values for urban related parameters in the lower Olentangy River mainstem in 2020 and 2022. Bold italic values are the highest between the two years. Values are color coded in accordance with the legend at the bottom.

Site ID	River Mile	Drainage Area (mi. ²)	Temperature mg/L (Mean)		pH S.U. (Mean)		Chloride, Total mg/L (Mean)		Conductivity uS/cm (Mean)		Total Dissolved Solids mg/L (Mean)		Total Cu (Mean) ug/L		Total Zn (Mean) ug/L	
			2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022
Olentangy River																
OLN05	14.9	482	18.7	18.7	8.03	7.92	40.0	48.5	562	571	340	400	2.6	7.1	14.8	10.6
OLN07	13.1	489	19.8	18.2	7.94	7.87	71.7	63.8	686	685	400	413	2.7	2.5	18.1	17.7
OLN08	12.0	490	19.3	18.9	8.08	7.97	47.8	58.8	603	676	363	412	3.3	3.2	10.0	39.6
OLN09	8.5	510	20.3	20.6	7.77	8.02	47.3	58.3	594	663	356	422	2.7	3.0	8.7	23.7
OLN10	6.8	516	19.8	19.7	8.01	7.97	48.8	64.5	587	654	353	405	2.7	3.4	9.3	86.3
OLN11	5.5	524	19.6	19.6	8.00	8.02	47.8	60.3	580	661	345	403	2.8	3.6	12.4	54.6
OLN12	4.5	529	19.7	22.5	7.80	7.92	40.3	59.5	528	626	320	393	2.9	5.1	10.6	16.4
OLN01	3.9	531	19.1	20.4	8.01	8.03	41.3	59.5	522	643	308	387	3.0	10.4	9.5	17.4
OLN02	2.0	537	19.6	19.9	8.08	8.00	44.8	65.3	538	652	317	405	2.9	3.0	9.8	10.8
OLN03	1.5	537	19.0	19.5	8.14	7.98	48.0	70.7	570	710	337	413	3.2	4.4	9.6	16.9
OLN04	0.3	543	19.3	19.7	8.08	7.92	52.0	71.3	590	711	347	417	2.6	3.1	8.6	16.9
Small River Narrative Threshold Rankings	<50th Percentile		<21.0		<8.2		<38		<650		<460.0		ND		<5	
	<75th Percentile		<23.0		<8.3		<47.5		<723.8		<490.0		<5		<18	
	<90th Percentile		<25.0		<8.5		<71.7		<800		<528.7		<15		<30	
	<95th Percentile		<25.9		<8.6		<96.4		<96.4		<854.5		<557.6		<23.5	
	>95th Percentile		>25.9		>8.6		>96.4		>96.4		>854.5		>557.6		>23.5	
Source			Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP	

conductance values for large rivers in the ECBP ecoregion are a median of 680 $\mu\text{S}/\text{cm}$ and a statistical maximum of 776 $\mu\text{S}/\text{cm}$.

2022 Specific Conductance Results

Mean specific conductance values exhibited a pattern similar to TDS and total chloride in the lower Olentangy mainstem in both 2020 and 2022 (Table 27). Mean conductance values were below the median reference value of 650 $\mu\text{S}/\text{cm}$ at all except the site downstream from the ECC discharge in 2020 with a median value of 700 $\mu\text{S}/\text{cm}$. Mean values in 2022 were consistently higher with several above the median reference value, but below the 75th percentile. The highest mean value of 711 $\mu\text{S}/\text{cm}$ was less than a third of the specific conductance value of 2400 $\mu\text{S}/\text{cm}$ that equates to the 1500 mg/L TDS water quality criterion. The longitudinal trend was for mean values to increase downstream much more so than in 2020.

Temperature and pH

The grab sample data for mean temperature and pH included in Table 27 revealed no exceedances of water quality criteria and only one exceedance of the regional reference median threshold. Differences between 2020 and 2022 were well within normal variations with a mix of highest values occurring in both 2020 and 2022, but being only a few tenths of degrees apart.

Mean pH levels were similar throughout the mainstem in both 2020 and 2022 (Table 27). All but a few means ranged between 7.9-8.0 S.U. in both 2020 and 2022. All pH means were below the median regional reference threshold of 8.2 S.U. in both years.

Copper and Zinc

Copper and zinc are two heavy metals that are frequently detected in urbanized watersheds. Mean copper values were all less than the 75th percentile reference value of 5 $\mu\text{g}/\text{L}$ in 2020 (Table 27). In 2022 mean values at three locations exceeded the 75th percentile reference value with the highest mean of 10.4 $\mu\text{g}/\text{L}$ at OLN01 (RM 3.9) downstream from the Dodridge Dam. None of these levels pose any threat to aquatic life, but are indicative of urban runoff.

Mean zinc values generally ranged below the 75th percentile value of 18 $\mu\text{g}/\text{L}$ in both 2020 and 2022 except at four sites in 2022. Mean values at OLN08, OLN09, OLN10, and OLN11 ranged from 23.7 $\mu\text{g}/\text{L}$ at OLN09 (RM 8.5) to 86.3 $\mu\text{g}/\text{L}$ at OLN10 (RM 6.8), with the latter and two other values exceeding the 95th percentile for ECBP small river reference sites of 37 $\mu\text{g}/\text{L}$ (Table 27). Again, these do not necessarily pose a threat to aquatic life, but are indicative of urban runoff.

Heavy Metals and Organic Compounds

Heavy metal and organic compounds in water are generally regarded as indicators of acute and chronic toxicity that were readily detectable at harmful amounts prior to the mandating of controls for point sources by the 1972 CWA and thereafter from other sources via other laws

and regulations. Since the development of water quality based limitations in NPDES permits and the general cleanup of other sources of metal and organic contaminants, measuring concentrations and even detecting metals and some organics in the water column has become rare to non-existent. Analyzing for metals and organic compounds in sediments has been emphasized more as these compounds have been at or below detection in the water column. Sediments can retain these compounds longer and likely represent a longer term measure of the true levels of contamination by these compounds.

Water Column Metals

Heavy metals analyzed in grab water samples included arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), nickel (Ni), lead (Pb), silver (Ag), and zinc (Zn) in their total recoverable state (Table 28). Hardness was calculated from the measured concentrations of magnesium (Mg) and calcium (Ca) to determine the hardness dependent water quality criteria for each heavy metal at each site. Hardness levels ranged from a low of 237 mg/L (OLN01) to a high value of 257 at OLN08 (RM 12.0). None of the seven (7) heavy metal parameters had any exceedances of the chronic outside mixing zone maximum (OMZM) or average (OMZA) criteria at the average hardness measured in 2022. All metals including iron (Fe) had measured levels that were an order of magnitude or more below the water quality criteria with no distinct patterns related to any sources.

Sediment Metals

Metals in sediment were analyzed for the same seven (7) parameters as in the water column (Table 29). The results were compared to Ohio EPA Sediment Reference Values (SRV; Ohio EPA 2008) and the Probable Effect Concentration (PEC) and Threshold Effect Concentration (TEC) levels of MacDonald et al. (2000). The PEC means that most species and taxa may be adversely affected whereas the TEC means that the most sensitive species and taxa may be affected. There were no exceedances of the more serious PEC threshold in 2022, but several exceedances of the TEC threshold for all arsenic values plus the SRV at OLN09 (RM 8.50), copper at seven sites (7) for both the TEC and SRV, nickel at all sites, lead at all except one site, and zinc at eight (8) sites, four (4) of which exceeded both the TEC and SRV thresholds. The general preponderance for having both TEC and SRV exceedances was in the more urbanized lower mainstem, a reflection of the most likely source of these compounds.

Sediment Organics

Organic chemicals in sediment were analyzed in 2022 for polycyclic aromatic hydrocarbon (PAH) and semi-volatile organic compounds. Of the nine semi-volatile organic compounds that were analyzed six had detectable results and only one, pyridine, was at a high risk concentration of concern (Table 30). Most are common by products of various manufacturing processes and the likely source is urban runoff or legacy pollution. Six (6) of the nine (9) semi-volatile compounds that were analyzed for in sediment were detected at least one site in 2022. Using thresholds cited in Buchman (2008), there was a single value for pyridine that had a high risk level for that compound. Two compounds, methylene chloride and acetone exceeded the lowest risk levels for each most occurring at the lower most three sites, OLN02, OLN03, and

Table 28. Mean concentrations of selected heavy metals in grab water samples collected at 11 ambient locations in the lower Olentangy River mainstem during June-October 2020 and 2022. The Ohio water quality criteria for each parameter appear at the bottom of the table.

Site ID	River Mile	Drainage Area (mi. ²)	Hardness mg/L		Arsenic µg/L		Cadmium µg/L		Chromium µg/L		Copper µg/L		Iron µg/L		Lead µg/L		Nickel µg/L		Silver µg/L		Zinc µg/L	
			2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022
Olentangy River																						
OLN05	14.9	482	250	245	2.00	2.32	0.05	0.05	--	0.96	2.65	7.08	275	297	0.33	0.48	4.35	4.58	--	0.03	9.25	10.63
OLN07	13.1	489	255	238	1.45	1.67	0.06	0.06	--	0.78	2.65	2.52	245	176	0.34	0.32	5.45	5.05	--	0.03	17.20	17.68
OLN08	12.0	490	250	257	1.80	2.13	0.07	0.05	--	1.07	2.70	3.22	230	193	0.29	0.37	4.80	5.07	--	0.03	7.75	39.62
OLN09	8.5	510	240	253	2.00	2.18	0.06	0.05	--	0.89	2.75	3.03	290	262	0.38	0.45	4.80	4.90	--	0.03	8.80	23.67
OLN10	6.8	516	240	247	2.00	2.13	0.05	0.05	--	1.30	2.65	3.40	265	263	0.34	0.40	4.70	4.78	--	0.03	8.80	86.27
OLN11	5.5	524	230	245	2.00	2.23	0.05	0.05	--	1.37	2.85	3.58	435	352	0.62	0.61	4.70	5.00	--	0.03	10.10	54.60
OLN12	4.5	529	185	245	2.35	2.35	0.07	0.14	--	2.33	3.00	5.08	395	343	0.66	0.66	4.45	5.17	--	0.03	10.40	16.35
OLN01	3.9	531	195	237	2.00	2.30	0.05	0.06	--	1.48	2.95	10.35	405	350	0.61	0.62	4.15	4.85	--	0.03	9.35	17.40
OLN02	2.0	537	190	242	2.05	2.23	0.05	0.05	--	1.33	2.85	2.98	440	322	0.78	0.61	4.30	4.83	--	0.03	9.65	10.80
OLN03	1.5	537	210	250	2.00	2.15	0.07	0.05	--	1.23	2.70	4.35	315	348	0.54	0.72	4.35	4.88	--	0.03	9.70	16.88
OLN04	0.3	543	220	248	1.85	2.05	0.05	0.05	--	1.30	2.60	3.05	265	308	0.56	0.80	4.40	4.75	--	0.03	8.30	23.18
Ohio WQS for Aquatic Life			<OMZA ¹		<150		<4.8				<19.4		<1000		<19		<107				<246	
			≥OMZA ¹		≥150		≥4.8				≥19.4		≥1000		≥19		≥107				≥246	
			≥OMZM ¹		≥340		≥11.8				≥27				≥363		≥966				≥246	
			≥IMZA ¹		≥680		≥23.7				≥62.6				≥726		≥1931				≥494	

¹Ohio water quality criteria for aquatic life at a hardness of 235 mg/L; OMZA-Outside Mixing Zone Average; OMZM-Outside Mixing Zone Maximum; IMZM-Inside Mixing Zone Maximum

Table 29. Concentrations of selected heavy metals in bulk sediment samples collected at 11 ambient locations in the Olentangy River mainstem in October 2022. The Ohio EPA sediment reference values (SRV) and MacDonald et al. (2000) threshold effect (TEC) and probable effect (PEC) thresholds are indicated at the bottom of the table.

Site ID	River Mile	Drainage Area (mi. ²)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Chromium (mg/kg)	Iron (mg/kg)	Nickel (mg/kg)	Lead (mg/kg)	Zinc (mg/kg)	Detects	Exceedances
Olentangy River												
OLN05	14.9	482	22.0	0.63	41	23.8	33000	44	29	161	8	5
OLN07	13.1	489	20.0	0.54	46	20.4	31000	47	26	145	8	5
OLN08	12.0	490	18.0	0.47	34	17.8	30000	35	25	123	8	5
OLN09	8.5	510	28.0	0.47	36	17.6	33000	38	28	174	8	5
OLN10	6.8	516	16.0	0.49	27	14.8	22000	27	21	111	8	2
OLN11	5.5	524	14.0	0.46	27	13.7	20000	27	24	112	8	3
OLN12	4.5	529	13.0	0.43	27	15.0	20000	28	26	104	8	3
OLN01	3.9	531	19.0	0.38	25	13.1	25000	29	30	133	8	4
OLN02	2.0	537	15.0	0.56	37	18.4	26000	29	33	172	8	5
OLN03	1.5	537	15.0	1.50	45	18.4	22000	25	37	178	8	6
OLN04	0.3	543	18.0	0.64	130	20.5	27000	32	38	202	8	5
Ohio EPA		SRV	25.1	0.8	33	40	51000	61	47	170		
MacDonald et al. (2000)		PEC	33.0	5	--	43.4	--	49	128	459		
		TEC	9.8	0.99	32	111	--	23	23	121		

Table 30. Concentrations of semi-volatile organic compounds in bulk sediment samples collected at 11 ambient locations in the lower Olentangy River mainstem in October 2020 and 2022. Threshold exceedances are color coded with values in the footnotes. Values in blank cells were below the MDL.

Site ID	River Mile	Drainage Area (sq. mi.)	Methylene Chloride (mg/kg)		bis(2-Ethylhexyl)phthalate (mg/kg)		Dibenzofuran (mg/kg)		Acetone (mg/kg)		Benzoic Acid (mg/kg)		Pyridine (mg/kg)		Number of Detections	
			2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022
Olentangy River																
OLN05	14.9	482	0.560	2.700	ND	ND	ND	ND	2.700	4.900	0.140	ND	ND	ND	5	2
OLN07	13.1	489	ND	ND	ND	ND	ND	ND	5.700	ND	ND	ND	ND	ND	2	0
OLN08	12.0	490	ND	3.700	ND	ND	ND	ND	1.800	ND	0.081	ND	ND	ND	2	1
OLN09	8.5	510	ND	ND	ND	ND	0.054	ND	ND	ND	ND	ND	ND	ND	1	0
OLN10	6.8	516	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0	0
OLN11	5.5	524	ND	ND	ND	ND	0.038	ND	ND	ND	ND	ND	ND	ND	1	0
OLN12	4.5	529	ND	ND	0.054	ND	ND	ND	ND	ND	ND	ND	ND	ND	2	0
OLN01	3.9	531	ND	ND	0.130	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	0
OLN02	2.0	537	ND	2.700	0.100	ND	ND	ND	ND	24.000	0.096	3.300	0.510	ND	3	3
OLN03	1.5	537	ND	2.300	1.400	ND	0.041	ND	1.000	7.200	ND	5.600	ND	ND	3	3
OLN04	0.3	543	ND	2.400	ND	ND	ND	ND	ND	16.000	0.140	3.600	ND	ND	2	3
Key	Low Risk		2.00 ^a		0.18 ^c		0.415 ^c		0.04 ^e		0.65 ^c		0.10 ^b		22	12
	High Risk						5.1 ^a						0.50 ^b			
	^a NOAA SQUIRT Guides <i>Hyaella azteca</i> bioassay threshold ("lowest reliable target").															
	^b NOAA SQUIRT Guides: Dutch Sediment Serious Contamination Levels "Target vs. Intervention."															
	^c EPA Region III BTAG, Freshwater Sediment Screening Benchmarks (Risk Comparison Values), 8/2006															
	^d Ecological Screening Values for Surface Water, Sediment, and Soil by G. P. Friday (WSRC-TR-98-00110); value represents the intervention value															
	^e U.S. EPA. 2015. Region 4 Ecological Risk Assessment Supplemental Guidance															

OLN04. Two (2) site (OLN05 and OLN08) in the upper portion of the lower Olentangy mainstem had low risk exceedances for methylene chloride and acetone The high risk exceedance of pyridine that occurred in 2020 at OLN02 at Fifth Avenue was not repeated in 2022. This compound is a byproduct of a variety of chemical manufacturing processes including medicines, vitamins, food flavorings, pesticides, paints, dyes, rubber products, adhesives, and water-proofing for fabrics. The remaining parameters had detections, but most were at single or only 2-3 sites. There was no apparent pattern in the total number of compounds detected by location which ranged from zero to five (5), the latter at the upstream most site OLN05 (RM 14.90). There were 22 overall detections in 2020 compared to 12 in 2022.

Polycyclic Aromatic Hydrocarbon (PAH) compounds are more commonly detected in sediment samples especially in urban areas. All of the detected PAH compounds are by products of coal tar, gasoline exhaust, and incomplete combustion and several are known carcinogens. Most of these compounds are not manufactured and are more commonly detected in urban rivers and

streams with runoff from asphalt pavement and heavy automobile traffic as the primary sources.

All fifteen (15) of the PAH compounds that were analyzed for were detected in the lower Olentangy mainstem in 2022. Seven (7) compounds were detected at every site and three (3) others were detected at all except the upstream most site which also had the lowest total PAH concentration in 2020 (Table 31). Four (4) compounds that were detected in 2020 were not detected at any site in 2022 – acenaphthene, carbazole, dibenzo(a,h)anthracene, and fluorene. Most threshold exceedances occurred at and downstream from OLN07 (RM 13.1). The total PAH detections numbered 144 in 2020 compared to 82 in 2022. Of these TEL/LEL exceedances numbered 99 in 2020 and 82 in 2022. However, the more serious PEC/SEL exceedances were more frequent in 2022 with 41 instances compared to only 12 in 2020. Exceedances of the lesser threshold (TEC) and low effect (LEL) thresholds were common for some PAH compounds including dibenzo(a,h)anthracene, phenanthrene, benzo(a)Anthracene, benzo(k)fluoranthene, chrysene, benzo(b)fluoranthene, pyrene, and fluoranthene in 2020. The PEC/SEL exceedances occurred most frequently for phenanthrene, benzo(a)anthracene, chrysene, pyrene, and fluoranthene in 2022 consistently between OLN09 (RM 8.50) downstream to OLN04 (RM 0.30). While the detections of PAH compounds are an indication of contaminants in urban runoff to the lower Olentangy mainstem, compared to other urban areas in Ohio and the Midwest the levels of organic chemicals in sediments were comparatively low in 2020, but similar in 2022.

Physical Habitat for Aquatic Life

The physical habitat of a stream or river is a primary determinant of biological quality and potential. Rivers and streams in the glaciated Midwest, left in their natural state, typically offer pool-run-riffle sequences, moderate to high sinuosity, and well-developed channels with deep pools, heterogeneous substrates, and cover in the form of woody debris, hard substrates, and aquatic macrophytes. The Qualitative Habitat Evaluation Index (QHEI) categorically scores basic components of stream and riverine habitat into ranks according to the degree to which those components are found compared to a natural state, or conversely, in an altered or modified state. In the middle Scioto River study area, QHEI scores and physical habitat attributes were recorded in conjunction with the fish sampling conducted at each site. QHEI scores >60 are generally regarded as having the potential to support attainment of the WWH aquatic life use designation and scores >75 indicate excellent habitat. Conversely scores less than 60 have limited potential to support WWH and scores less than 45 indicate an inability to attain WWH, thus interventions to improve the QHEI would be needed. Rankin (1989, 1995) developed a matrix of QHEI attributes that include good attributes that enhance physical habitat and modified attributes that deter attainment of WWH. Generally ratios of modified to good attributes of >2.0 indicate that altered habitat is a deterrent to attaining WWH.

In rivers such as the Olentangy, impoundment by low head dams and encroachment by treeless levees and support columns for major highway overpasses are the principal sources of habitat modification that have the potential to preclude WWH attainment. There are four (4) impoundments remaining in the 2022 Olentangy study area, the largest of which is created by

Table 31. Concentrations of polycyclic aromatic hydrocarbon (PAH) compounds in bulk sediment samples collected at 11 ambient locations in the Olentangy River mainstem in October 2020 and 2022 with exceedances of Low and Threshold Effect (LEL, TEC) and Severe and Probable Effect (SEL, PEC) color coded. ND in cells are below the MDL for that compound.

Site ID	River Mile	Drainage Area (sq. mi.)	Anthracene (mg/kg)		Acenaphthene (mg/kg)		Carbazole (mg/kg)		Dibenzo(a,h)anthracene (mg/kg)		Benzo(ghi)perylene (mg/kg)		Indeno(1,2,3-c,d)pyrene (mg/kg)		Phenanthrene (mg/kg)		Benzo(a)Anthracene (mg/kg)		Benzo(k)fluoranthene (mg/kg)		Benzo(a)pyrene (mg/kg)		Chrysene (mg/kg)		Benzo(b)fluoranthene (mg/kg)		Pyrene (mg/kg)		Fluoranthene (mg/kg)		Fluorene (mg/kg)		Total PAH (mass)			
			2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022
			Olentangy River																																	
OLN05	14.9	482	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.940	ND	ND	0.087	ND	0.076	ND	0.089	ND	0.071	ND	0.084	ND	0.092	ND	0.140	ND	0.190	ND	ND	ND	0.829	0.940		
OLN07	13.1	489	0.059	ND	ND	ND	0.036	ND	ND	ND	0.035	ND	0.059	ND	0.270	ND	0.190	ND	0.220	ND	0.180	ND	0.200	ND	0.210	ND	0.350	ND	0.470	ND	0.041	ND	2.320	0.000		
OLN08	12.0	490	0.035	ND	ND	ND	ND	ND	ND	ND	0.024	ND	0.031	ND	0.150	ND	0.120	ND	0.140	ND	0.100	ND	0.140	0.480	0.140	ND	0.220	0.830	0.320	1.100	ND	ND	1.420	2.410		
OLN09	8.5	510	0.200	0.690	0.076	ND	0.240	ND	0.083	ND	0.180	3.000	0.240	3.500	1.200	4.500	1.100	2.700	1.400	2.200	1.300	3.600	1.400	4.700	1.900	3.100	2.000	7.800	2.100	10.00	0.120	ND	13.539	45.790		
OLN10	6.8	516	0.071	0.490	ND	ND	0.120	ND	0.049	ND	0.100	2.200	0.130	2.600	0.810	2.700	0.490	2.200	0.730	1.700	0.560	2.600	0.660	3.300	0.810	2.300	1.000	4.700	1.600	7.500	0.044	ND	7.174	32.290		
OLN11	5.5	524	0.160	ND	0.064	ND	0.180	ND	0.065	ND	0.150	ND	0.250	ND	1.000	1.200	1.100	ND	1.300	ND	0.280	1.100	1.500	1.500	1.800	ND	1.600	2.200	2.000	2.900	0.087	ND	11.536	8.900		
OLN12	4.5	529	0.074	ND	0.035	ND	0.110	ND	0.043	ND	0.077	1.300	0.110	1.600	0.640	2.100	ND	1.200	0.980	1.000	0.710	1.800	0.860	2.200	1.200	1.500	1.200	3.200	1.200	4.700	0.052	ND	7.291	20.600		
OLN01	3.9	531	0.040	2.000	ND	ND	0.067	ND	0.069	ND	0.180	2.900	0.220	3.600	0.330	10.00	0.340	4.200	0.460	2.800	0.470	4.700	0.470	5.600	0.650	3.300	0.710	9.400	0.880	14.00	ND	ND	4.886	62.500		
OLN02	2.0	537	0.031	0.510	ND	ND	0.051	ND	0.041	ND	0.110	1.300	0.140	1.900	0.240	4.300	0.240	2.400	0.360	2.200	0.350	3.400	0.360	4.300	0.460	2.900	ND	6.300	0.690	9.800	ND	ND	3.073	39.310		
OLN03	1.5	537	0.215	0.400	0.074	ND	0.190	ND	0.120	ND	0.260	ND	0.350	1.400	1.300	3.600	1.300	2.200	1.400	1.800	1.500	3.100	1.600	3.900	2.200	2.700	1.800	5.700	2.600	8.200	0.110	ND	15.019	33.000		
OLN04	0.3	543	0.046	ND	ND	ND	0.066	ND	0.039	ND	0.085	ND	0.110	1.300	0.340	3.000	0.370	1.700	0.510	1.700	0.440	2.600	0.510	3.400	0.640	2.400	0.700	4.600	0.930	6.900	0.025	ND	4.811	27.600		
MacDonald et al. (2000) Thresholds	PEC		>0.845	--	--	--	--	--	--	--	--	--	--	>=1.170	>=1.050	--	--	1.290	--	--	--	1.290	--	1.520	--	1.520	2.230	0.536								
	TEC		>0.057	--	--	--	--	--	--	--	--	--	--	>0.204	0.108	--	--	0.166	--	--	--	0.166	--	0.195	--	0.195	0.423	0.077								
Persaud et al. (1993) Thresholds	SEL		>370	>0.088	--	--	--	>130	>320	>320	>950	>1480	>1340	>1440	>460	>1340	>850	>1020	>160	>10,000																
	LEL		>0.220	>0.0067	--	--	--	>0.060	>0.170	>0.200	>0.560	>0.320	>0.240	>0.370	>0.340	>0.240	>0.490	>0.750	>0.190	>4.000																

the Dodridge Street Dam that extends 0.45 miles upstream to the Union Cemetery Dam. The other three (3) impoundments are formed by smaller dams that created substantially smaller impoundments of 0.1-0.2 miles in length each. In terms of fish passage the Dodridge Street and Union Cemetery dams comprise the most impassable barriers with the other low head dams likely being passable by strong swimming fish species during elevated flow events.

Encroachment by urban development and major highways is the most apparent downstream from I-270 North and especially so in the mainstem downstream from the Dodridge Street Dam. Portions of the mainstem between I-270 North and Henderson Rd. were relocated in the late 1970s to accommodate the expansion of St. Rt. 315 into a major freeway connecting I-270 with major interstate routes in downtown Columbus. Mitigation consisted of state-of-the-art measures for that time period including artificial riffles comprised of limestone riprap. Over time these have been integrated into the natural substrate and what recovery the river channel has been able to accomplish on its own to form riverine habitat with the semblance of pool-run-riffle sequences. Bicycle and walking trails follow the mainstem from the mouth at Confluence Park upstream to Highbanks Metropark with most shrouded by a mature tree canopy, but with some treeless mowed banks in selected parks and neighborhoods.

2022 QHEI Results

Habitat as measured by the QHEI in the lower Olentangy mainstem in 2022 was good (>60) or excellent (>75) at all except the two impounded sites (OLN11 and OLN12 in the Dodridge Street and North Broadway Dam impoundments, this despite the aforementioned encroachments and habitat modifications (Figure 33). Formerly impounded sites in the lower mainstem had excellent QHEI scores with some sites gaining 50 QHEI points following a dam removal (MBI 2022). The 2020 and 2022 results were entirely similar being within a few QHEI points at a given site.

A QHEI matrix showing both good and poor habitat attributes (after Rankin 1995) was developed for each site in the lower Olentangy River mainstem study area (Table 32). The matrix includes an accounting of the number good and modified habitat attributes (Rankin 1989, 1995) and their ratios. Modified attributes are subdivided between high and moderate influence as defined by Rankin (1989) based on an analysis of the Ohio statewide database. The sites within the North Broadway Dam (OLN11, RM 5.65) and Dodridge Street Dam (OLN12, RM 4.30) impoundments were the only locations with one or two high influence modified attributes in the form of no recovery due to the impounded habitat and no sinuosity. These sites also had the fewest good habitat attributes (4 and 4, respectively) and the highest ratios of modified to good attributes (2.00 and 2.00, respectively). The attributes counts at these sites were in the poor and fair range and the modified to good ratios were fair. The rest of the free flowing sites had 8-9 good attributes which is good to excellent. With the exception of OLN07 (RM 12.90) and OLN08 (Rm 12.30) with 3 and 4 modified attributes, these numbered 0 or 1 at the remaining free flowing sites. The excellent habitat in the lower mainstem downstream from the Dodridge Dam supported good to exceptional biota.

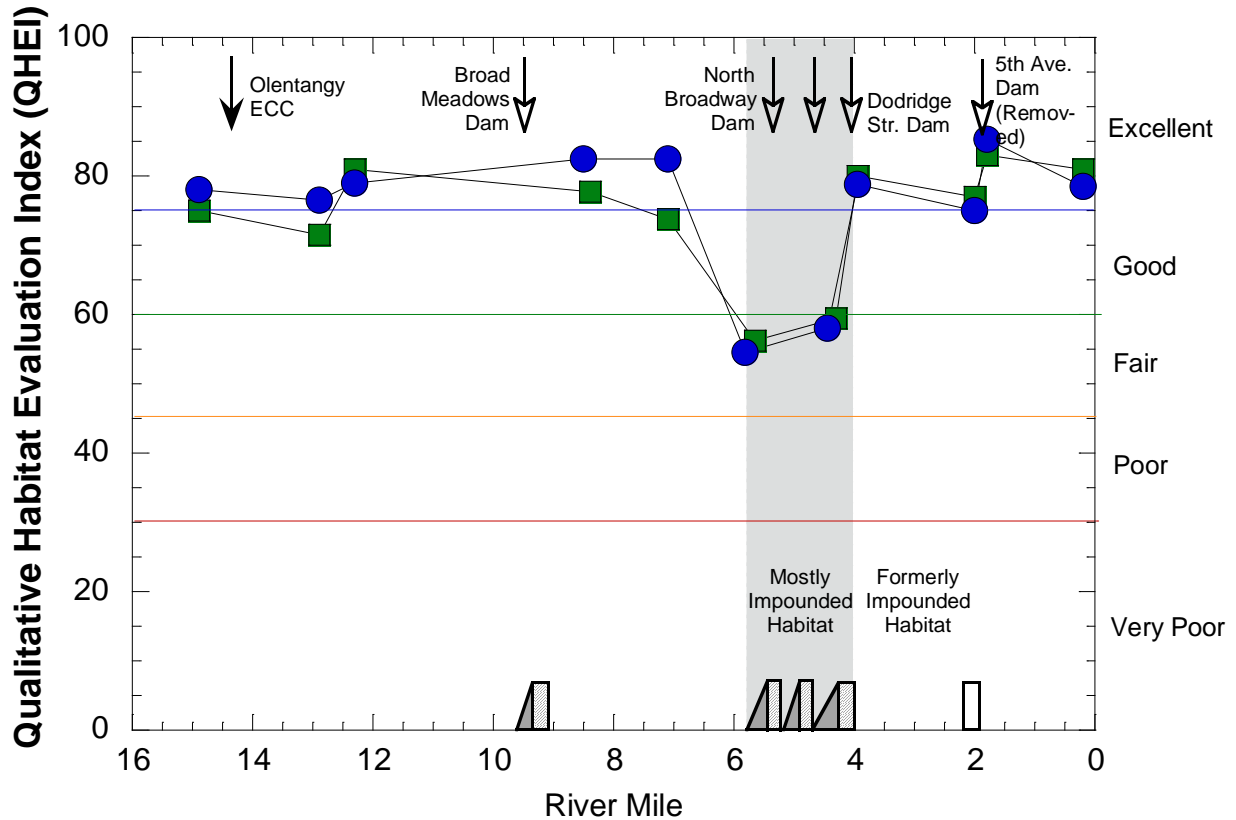


Figure 33. QHEI scores in the lower Olentangy River mainstem during June-October, 2020 and 2022. The narrative ratings of excellent, good, fair, poor, and very poor quality are shown by solid color lines. Discharges and significant dams are indicated along the top of the graphic.

Biological Assemblages – Fish

The fish assemblages of the lower Olentangy River mainstem between the upstream site at Powell Rd. to the mouth have been sporadically assessed in eight (7) of the past 36 years based on surveys in 1987, 1991, 1999, 2003, 2011, 2015, 2020, and 2022. The most complete surveys were conducted in 1999, 2003, 2020, and 2022 with the other years either having fewer locations sampled (1987, 1991) or covering only a portion of the 2020 and 2022 study area. The surveys in 2011 and 2015 in particular were done to provide before and after data for the Fifth Avenue Dam removal. The more complete surveys have been reported by Ohio EPA in two biological and water quality reports (Ohio EPA 2001, 2005) the latter including the entirety of the mainstem and numerous tributaries in the upper watershed. This analysis focuses on the 2022 results and what it adds to the analysis of assemblage indices and attributes. Summarized data tables appear in Appendix B.

2022 Fish Assemblage Results

A total of 39 native species, one (1) non-native species, and three (3) hybrids among 2,223 fish counted weighing 58.0 Kg were collected from the lower Olentangy River mainstem study area in 2022 in 11 samples at 11 sites (Appendix Table B-6).

Fish Assemblage Indices – IBI and MIwb

The two principal fish indices in Ohio are the Index of Biotic Integrity (IBI; Ohio EPA 1987) and the Modified Index of Well-Being (MIwb; Ohio EPA 1987) each with biological criteria codified in the Ohio WQS (OAC 3745-1-07[C] Table 7-1). Their development and usage are detailed in Ohio EPA (1987) and Yoder and Smith (1999) with the biological criteria derivation in Ohio EPA (1987, 1989), Yoder and Rankin (1995a), and application in Yoder (1995) and Yoder and Rankin (1998). There are three fish IBIs that are applied to Ohio inland rivers and streams – a headwater sites IBI, a wadeable IBI, and boatable IBI. These are distinct site types that also have their own biological criteria based on independent sets of reference sites. The biological criteria are further stratified by the five Level III ecoregions that occur across Ohio for the WWH use designation, but are applied on a statewide basis for the EWH use designation.

The mean fish IBI (based on one sampling pass) in 2022 was evaluated against the EWH, WWH, and MWH biocriteria as all three are designated to various subreaches in the lower Olentangy River study area. The EWH reach includes the three (3) upstream most sites with the median IBI below the biocriterion at one site (Figure 34). This contributed to the partial EWH attainment observed in this reach of the mainstem (see Table 3 on p. 13). The median IBI was just below the nonsignificant departure at OLN08 (RM 12.390). The IBI values surpassed the WWH biocriterion at the next two (2) WWH designated sites, declining in the impounded reaches at OLN11 (RM 5.65) and OLN12 (RM 4.30), but surpassing the MWH biocriteria. All median IBIs easily surpassed the WWH biocriteria at the remaining four (4) sites downstream from the Dodridge Street dam including the former Fifth Avenue dam impoundment where the existing MWH use designation was changed to WWH in 2022.

The mean MIwb was likewise evaluated against the EWH, WWH, and MWH biocriteria as they are designated to various subreaches in the lower Olentangy River study area. The MIwb failed to meet or come within the nonsignificant departure of the EWH biocriterion at two of the three (sites) in the EWH designated subreach in the upper mainstem (Figure 34). This also contributed to the partial attainment status for the EWH use designation in this reach of the mainstem (see Table 3 on p. 13). Beginning at the site downstream from the Broad Meadows Dam (OLN09, RM 8.40) all MIwb values met the WWH biocriterion downstream to the Dodridge Street impoundment (OLN12, RM 4.30) including the North Broadway Dam and Dodridge Dam impounded sites OLN11 (RM 5.56) and OLN12 (RM 4.50). The MIwb increased sharply downstream from the Dodridge Street Dam and remained above the WWH biocriterion at all sites including the former Fifth Avenue impoundment (OLN02, RM 2.00) where the MWH use designation was changed to WWH in 2022.

DELT Anomalies

DELT anomalies is a metric of the Ohio fish IBI and is measured as the percentage of fish in a sample that exhibit a deformity (D), an erosion (E), a lesion (L), or a tumor (T) based on an

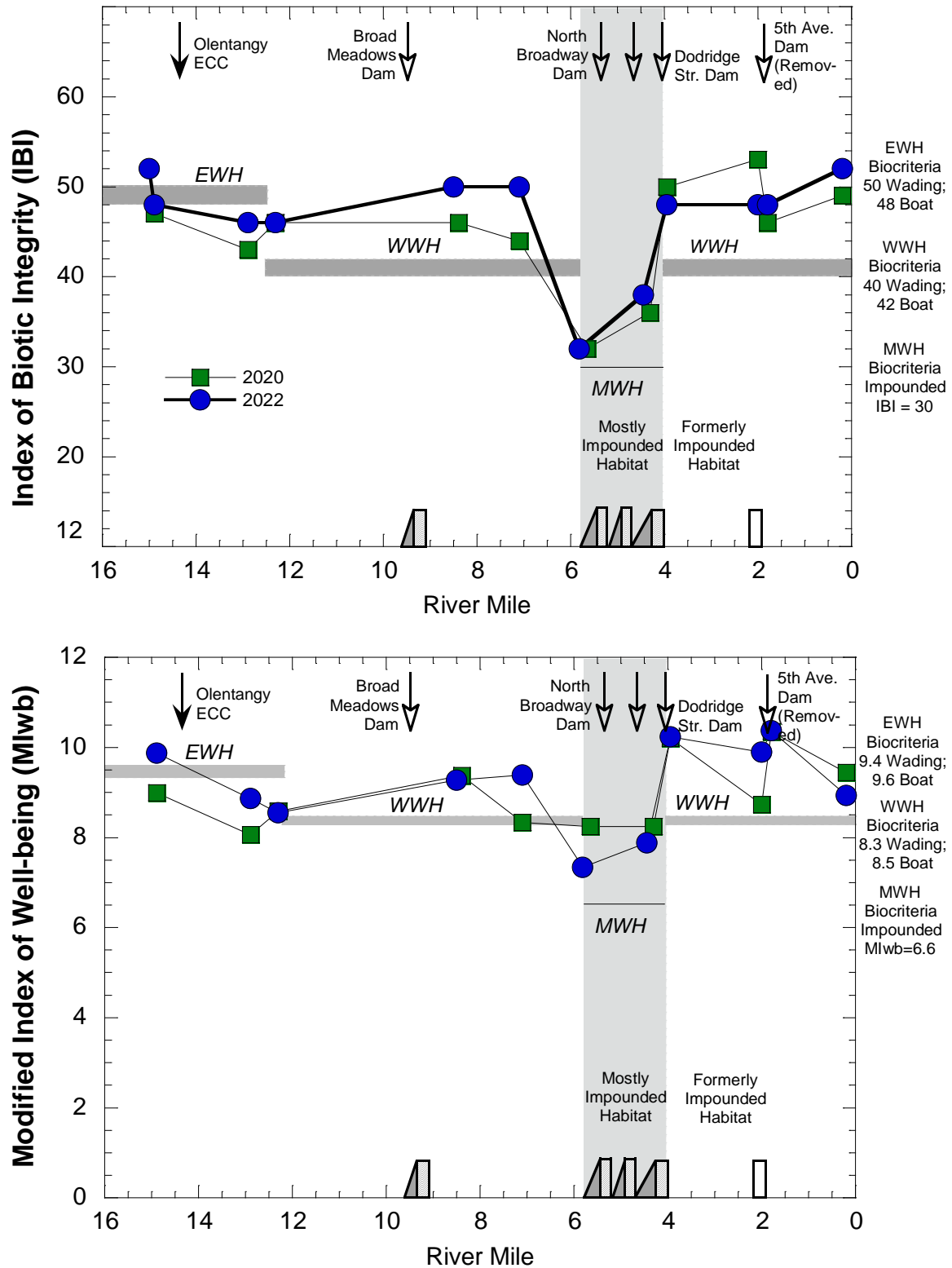


Figure 34. Index of Biotic Integrity (IBI) scores (upper) and Modified Index of Well-Being (MIwb) scores (lower) in the lower Olentangy River mainstem during June-October, 2020 and 2022. The biocriteria for the EWH, WWH, and MWH aquatic life uses are depicted by the shaded bars and solid lines. Discharges and significant dams are indicated along the top of the graphic.

external examination while processing a sample (Ohio EPA 1987; Sanders et al. 1999). It is unique among the IBI metrics in being the only direct indicator of fish health and it has served to be an indicator of different types of impacts on Ohio rivers and streams (Yoder and Rankin 1995b; Yoder and DeShon 2003). The percentage of fish with one or multiple DELT anomalies in the lower Olentangy River mainstem in 2022 was elevated above background levels (<0.5%) at all 11 sites in the mainstem (Figure 35). The two upstream most sites OLN05 (RM 14.90) and OLN07 (RM 12.90) had DELTs above 1.0%. DELTs declined at the next two sites and then increased at OLN10 (RM 7.10) to 2.0% and then increased to >5.0% at OLN11 (RM 5.65) and exceeded 3.0% at OLN01, OLN02, and OLN03. These results are a significant departure from the 2020 results and an indication of an increase in chronic stresses in 2022.

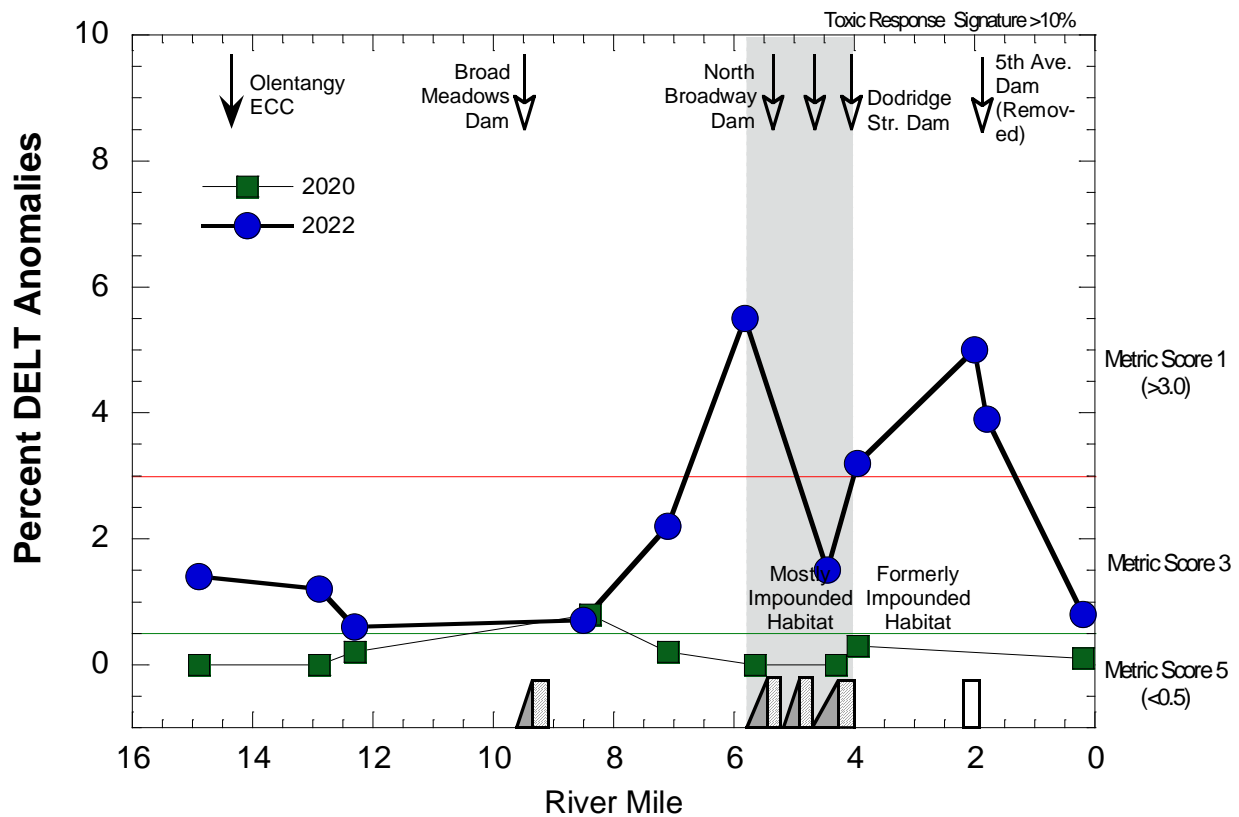


Figure 35. Percentage of fish with deformities, erosions, lesions, and tumors (DELT) in the lower Olentangy River mainstem during June-October, 2022. The 5 and 3 metric scoring thresholds are represented by solid green and red lines. Discharges and significant dams are indicated along the top of the graphic.

Fish Assemblage Response Indicators

Key fish assemblage response indicators were examined along the length of the 2022 mainstem and besides the two fish assemblage indices included the number of native species, %DELT anomalies, the number of sensitive species, the proportion of fish as simple lithophils, and the proportion of fish as highly tolerant species (Table 33). These cover the breadth of assemblage response to chemical, physical, and biological stressors and are based on narrative ranges and

Table 33. Fish assemblage response indicators in the lower Olentangy River mainstem between Powell Rd. and the mouth in 2020 and 2022. The results for each indicator are color coded in accordance with the key at the bottom of the table.

Site ID	River Mile	Drainage Area (mi. ²)	Fish Assemblage Response Indicators													
			IBI		MIwb		Native Species		%DELT Anomalies		Sensitive Fish Species		%Simple Lithophils		%Tolerant Fish	
			2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022
OLN05	15.00	482	47	50	9.0*	9.9	26.5	24.0	0.00	0.68	14.5	13.5	45.2	33.2	26.7	16.6
OLN07	12.90	489	43*	46 ^{ns}	8.1*	8.9*	22.0	25.0	0.00	1.18	12.5	15.0	42.9	30.6	25.8	27.1
OLN08	12.30	490	46 ^{ns}	46 ^{ns}	8.6*	8.6*	25.0	21.0	0.17	0.55	13.5	11.0	30.7	50.8	29.8	9.9
OLN09	8.50	510	46	50	9.4	9.3	21.0	20.0	0.76	0.68	10.0	11.0	39.5	60.3	19.0	2.1
OLN10	7.10	516	44	50	8.3	9.4	20.5	20.0	0.19	2.19	11.5	10.0	37.5	62.3	18.9	3.5
OLN11	5.82	524	32	32	8.2	7.3	18.0	12.0	0.00	5.45	6.0	5.0	20.3	38.8	47.9	34.1
OLN12	4.45	529	36	38	8.2	7.9	18.0	15.0	0.00	1.46	8.0	6.0	26.7	36.5	33.0	27.0
OLN01	3.95	531	50	48	10.2	10.2	30.0	31.0	0.26	3.17	17.0	16.0	31.4	43.7	22.2	22.2
OLN02	2.00	537	53	48	8.7	9.9	24.5	25.0	0.00	5.03	15.0	14.0	61.1	50.3	6.9	6.9
OLN03	1.80	537	46	48	10.4	10.4	29.0	28.0	0.00	3.86	18.0	14.0	48.7	38.2	19.2	8.7
OLN04	0.20	543	49	52	9.5	8.9	27.0	27.0	0.09	0.81	15.5	14.0	55.5	64.0	11.5	4.1
Narrative Ranking Thresholds	Excellent		44-60		>9.1		>25		0.00		>15		>30		<15	
	Good		38-43		8.0-9.0		>14		<1.3		11-15		>20-30		>15-30	
	Fair		26-37		5.8-7.9		>10		<3.0		3-10		>10-20		>30-50	
	Poor		19-25		4.0-5.7		>7		>10		1-2		>5-10		>50-70	
	Very Poor		12-18		<4.0		<7		>20		0		<5		>70	

Footnotes: a Narrative rating used in lieu of ICI (E - Exceptional; G - Good; F - Fair; P - Poor; VP - Very Poor. b As defined by Yoder and Rankin 1995) and Yoder and DeShon (2003).

thresholds described in Yoder and Rankin (1995b) and Yoder and DeShon (2003). One poor and five (5) fair responses were observed among all of the variables in 2020. This increased to nine (9) fair and four(4) poor responses in 2022, of which most were DELT anomalies. Two sites, both impounded, the North Broadway impoundment OLN11 (RM 5.56) and the Dodridge Street impoundment OLN12 (RM 4.50) had all of the indicator values at fair or poor. The IBI and sensitive fish species were fair at both sites and %DELTs were poor and fair at OLN11. Of the remainder, 37 were in the excellent range and 32 in the good range for the biological response indicators in 2020 while 26 were excellent and 37 good in 2022 (Table 32).

Biological Assemblages – Macroinvertebrates

The macroinvertebrate assemblages of the lower Olentangy River mainstem between the upstream site at Powell Rd. to the mouth have, like fish, been sporadically assessed in seven (7) of the past 36 years based on surveys in 1987, 1991, 2003, 2011, 2015, 2020, and 2022. The most complete surveys were conducted in 2003, 2020, and 2022 with the other years either having fewer locations sampled (1987, 1991) or covering only a portion of the 2020 and 2022 study area. The surveys in 2011 and 2015 in particular were done to provide before and after data for the Fifth Avenue Dam removal. The data has been reported by Ohio EPA two biological and water quality reports (Ohio EPA 2001, 2005) the latter including the entirety of the mainstem and numerous tributaries. This analysis focuses on the 2022 results and what the new data adds to the existing trend analyses of assemblage indices and attributes. Summarized data tables for 2022 appears in Appendix C.

2022 Macroinvertebrate Assemblage Results

A total of 178 macroinvertebrate taxa were collected from the modified Hester-Dendy (HD) artificial substrate samplers and in the qualitative dip net, handpick samples from 11 sites in the Olentangy River mainstem study area in 2022 (Appendix C). The HD samplers yielded 37,257 organisms across 104 taxa while the qualitative samples yielded 149 taxa.

Macroinvertebrate Assemblage Composition

The top 40 taxa in the lower Olentangy River in 2022 included 10 sensitive (intolerant and moderately intolerant) taxa, two (2) moderately tolerant taxa, and one (1) tolerant taxa with the remaining 19 taxa classified as facultative (Appendix C). There were eight (9) Ephemeroptera (mayflies) taxa, five (5) Trichoptera, and one (1) Plecoptera taxa for a total of 15 EPT taxa. There were nine (9) midge taxa of which one (1) was from the more sensitive Tanytarsini tribe. The remaining 18 taxa belonged to the other Dipteran and non-insect groups. Overall the macroinvertebrate assemblage reflected good quality in the lower Olentangy River study area.

Macroinvertebrate Assemblage Response Indicators

Key macroinvertebrate assemblage response indicators were also examined in addition to the Invertebrate Community Index (ICI) along the length of the 2022 mainstem including the number of total taxa, number of sensitive taxa in the qualitative sample, the proportion of tolerant taxa, the proportion of mayflies, the number of EPT taxa in the qualitative sample, the

proportion of toxic tolerant taxa, and proportion of organic enrichment tolerant taxa (Table 34). These cover the breadth of assemblage response to chemical, physical, and biological stressors and are based on narrative ranges and thresholds described in Yoder and Rankin (1995b) and Yoder and DeShon (2003). Fair, poor, and very poor indicator responses were observed in the Dodridge Street Dam impoundment at site OLN12 (RM 4.50) for the ICI (fair), the number of sensitive taxa (poor), the proportion of tolerant taxa (fair), the proportion of mayflies (very poor), qualitative EPT taxa (poor), the proportion of toxic tolerant taxa (fair), and the proportion of organic enrichment tolerant taxa (very poor). The %Mayflies was fair or poor at OLN07, OLN08, OLN09, and OLN10 and was a reduction from good and excellent values in 2020. Fair and poor responses were also observed at OLN11 (RM 5.50) in the North Broadway Dam impoundment for the ICI (fair), total taxa (fair), the number of sensitive taxa (poor), the proportion of mayflies (very poor), qualitative EPT taxa (poor), and the proportion of organic enrichment tolerant taxa (poor). The only other fair responses were for the ICI (fair), proportion of mayflies (fair), and %organic tolerant taxa at OLN11 (RM 5.50). The responses were predominantly in the excellent range between the upstream most site at OLN05 (RM 14.40) downstream to site OLN10 (RM 7.00) upstream from Henderson Rd. With the exception of the aforementioned fair responses, the remainder was mix of excellent and good downstream from the Dodridge Street Dam to the mouth. The modified habitat and flow in the two impoundments and the resulting exacerbation of nutrient enrichment were the principal causes of the numerous fair, poor, and very poor responses observed at OLN11 and OLN12.

Macroinvertebrate Assemblage Indices and Metrics

The principal macroinvertebrate assemblage index used in Ohio is the Invertebrate Community Index (ICI) developed by Ohio EPA (1987). The ICI is structured similar to the fish IBI being comprised of 10 metrics each calibrated to 6, 4, 2, and 0 metric scores by drainage area on a statewide basis. The ICI biological criteria are codified in the Ohio WQS (OAC 3745-1-07[C] Table 7-1). Their development and usage are detailed in Ohio EPA (1987) with the biological criteria derivation in Ohio EPA (1987, 1989) in DeShon (1995) and its application Yoder (1995) and Yoder and Rankin (1998).

The ICI in 2022 met or surpassed the EWH biocriterion at only two (2) sites in 2020 compared to nine (9) of the 11 sites in 2020 (Figure 36). This included the EWH designated upper reach downstream to I-270 and the WWH reach downstream to OLN10 (RM 7.00), upstream from Henderson Rd. ICI values declined substantially at two sites impounded by the Dodridge Street Dam (OLN12, RM 4.50) and the North Broadway Dam (OLN11, RM 5.50), failing to meet the MWH biocriterion at both sites in 2022. Impacts to both were primarily the result of the altered flow and impounded habitat. The ICI quickly recovered downstream from the Dodridge Street Dam and met the ICI biocriterion in this WWH designated reach downstream to the mouth. The 2022 results were uniformly reduced compared to 2020, failing EWH at OLN08 (RM 11.90), but still meeting the WWH biocriteria in the WWH designated reaches.

Synthesis of Results – Olentangy River Mainstem

Conditions for aquatic life and the attainment of aquatic life uses in the lower Olentangy River

Table 34. Macroinvertebrate assemblage response indicators in the lower Olentangy River mainstem between Powell Rd. and the mouth in 2020 and 2022. The results for each indicator are color coded in accordance with the key at the bottom of the table.

Site ID	River Mile	Drainage Area (mi. ²)	Macroinvertebrate Assemblage Response Indicators															
			ICI ^a		Total Taxa		Sensitive Qual. Taxa ^b		%Tolerant Macros ^b		%Mayflies ^b		Qualitative EPT Taxa ^b		Tolerant Taxa ^c		%Organic Tolerant Taxa ^c	
			2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022
Olentangy River																		
OLN05	14.9	482	54	E	75	66	25	25	1.3	0.0	30.2		28	28	0.3		5.5	
OLN07	13.3	489	54	46	80	67	25	21	0.2	0.5	44.3	10.0	25	20	0.1	0.1	2.2	13.8
OLN08	11.9	490	54	38*	87	70	31	23	0.6	0.5	22.9	15.5	29	25	0.1	0.0	5.4	8.6
OLN09	8.5	510	56	34 ^{ns}	69	67	18	20	0.1	0.3	43.4	6.5	21	21	0.0	0.0	3.4	20.7
OLN10	7.0	516	48	38	78	70	21	22	2.5	0.4	34.5	13.7	22	21	0.5	0.0	5.5	8.0
OLN11	5.5	524	24	20	58	46	2	3	12.5	13.2	15.1	19.9	2	3	0.8	0.0	22.5	20.3
OLN12	4.5	529	18	20	40	37	2	4	13.5	2.3	2.7	0.3	2	4	5.6	0.0	67.3	52.6
OLN01	3.9	531	48	VG	59	43	19	15	0.3	0.0	18.3		16	15	0.0		3.9	
OLN02	2.0	537	50	42	59	65	17	19	0.0	0.7	37.4	20.1	19	18	0.0	0.7	6.3	13.7
OLN03	1.7	537	E	38	52	60	18	19	0.0	0.7		20.7	21	16		0.0		15.9
OLN04	0.2	543	46	42	59	63	12	13	0.1	0.4	26.3	28.5	14	15	0.0	0.0	2.2	9.9
Narrative Ranking Thresholds	Excellent		≥42		>60		>16		≤5		≥30		>15		0		<5	
	Good		32-40		>40-60		11-16		>5-10		>20-30		11-15		<5		<15	
	Fair		14-30		>20-40		6-10		>10-25		>10-20		6-10		<20		≥15	
	Poor		8-12		>10-20		2-5		>25-50		>5-10		2-5		≥35		≥35	
Very Poor		0-6		<10		<2		≥50		≤5		<2		<60		>60		

^a - Narrative rating used in lieu of ICI (E - Exceptional; G - Good; F - Fair; P - Poor; VP - Very Poor; ^b - from Ohio EPA (2015a); ^c - as defined by Yoder and Rankin (1995) and Yoder and DeShon (2003).

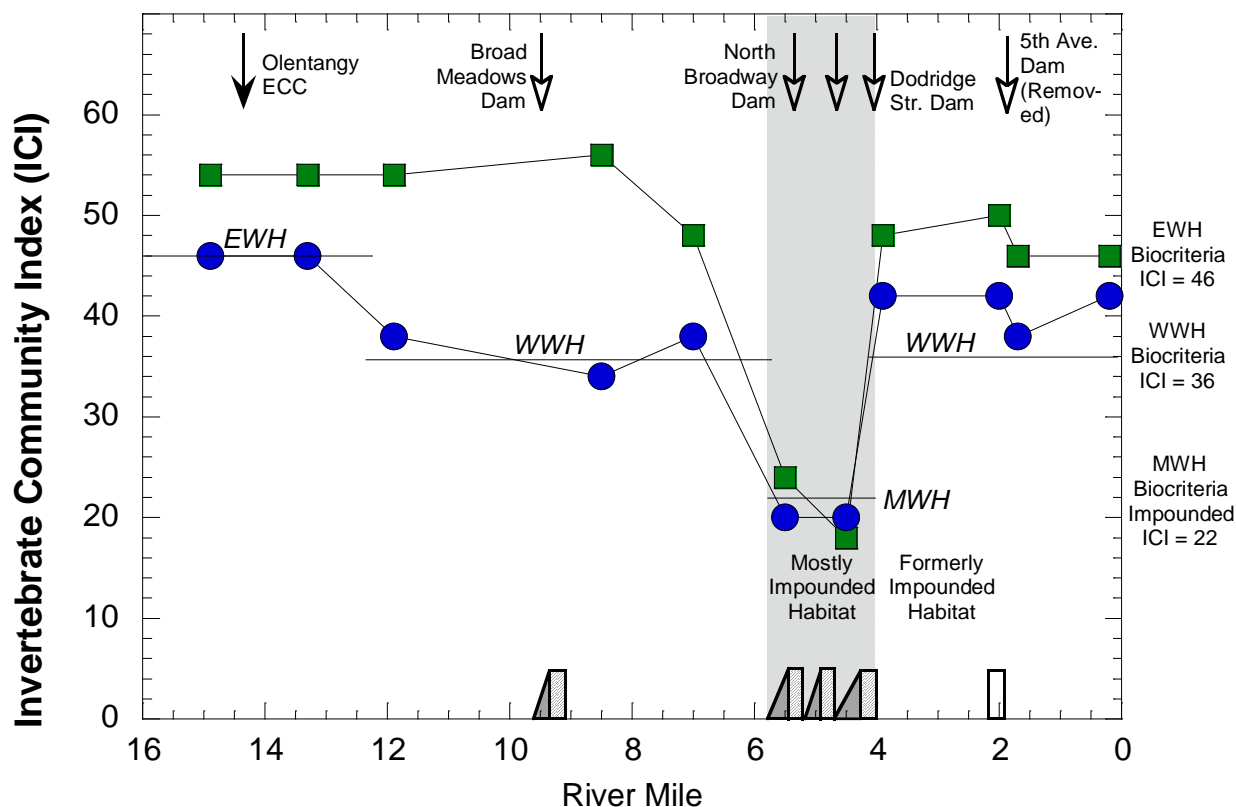


Figure 36. Invertebrate Community Index (ICI) scores in the lower Olentangy River mainstem during June-October, 2020 and 2022. The biocriteria for the EWH, WWH, and MWH aquatic life uses are depicted by the solid lines. Discharges and significant dams are indicated along the top of the graphic.

in southern Delaware and Franklin Counties have been less affected by the results of population growth that have impacted the Scioto River mainstem for more than 130 years by comparison. Part of this is due to the directing of wastewaters south of Columbus into the Scioto and its lower tributaries in central Ohio. Nonetheless, the Olentangy River has historically been polluted by human and industrial wastewaters and impacted by flow and habitat alterations (FLOW 2003). The extension of St. Rt. 315 into southern Delaware Co. and the construction of the Olentangy ECC to handle increased municipal wastewater flows prompted accelerated suburban development in the late 1970s and early 1980s that occurs yet today. Because of its high water quality and status as a State Scenic River additional steps were taken to ensure that the sewer system and treatment plant were state-of-the-art. Although partial surveys were conducted in 1987 and 1991, the first complete bioassessment of the Olentangy River mainstem was conducted in 1999 (Ohio EPA 2001). It and the 1999 and 2003 surveys (Ohio EPA 2001, 2005) serve as the baselines for the earlier and subsequent partial surveys of 2011 and 2015 that culminated in the more complete 2020 and 2022 bioassessments reported herein.

Synthesis of the 2022 Results and Key Response Indicators

Table 35 represents a synthesis of the aquatic life use attainment status, the biological criteria

by which attainment status is derived, the principal indicators of biological quality and response to predominant stressors, indicators of habitat quality, key aspects of the D.O. regime that are affected by organic and nutrient enrichment, and the key chemical indicators consisting of water column and sediment chemistry in 2022. Each response signature or index score was normalized to their narrative scales of exceptional, good, fair, poor, and very poor quality and condition and listed for each site. As such it presents a synthesis of the results that were previously described on an individual basis.

Aquatic life use attainment status is the governing indicator of environmental stressors and it was full for EWH at the upstream most site OLN05 (RM 14.90) and partial at OLN07 (RM 12.90) and OLN08 (RM 12.30) due to the failure of the MIwb to meet the applicable biocriterion at OLN07 and both the MIwb and ICI at OLN08. Exceedances of poor or very poor biological indicator thresholds for DELTs and %Mayflies and very poor exceedances for sediment chemical exceedances started at OLN09 (RM 8.50) and extended downstream to the Dodridge Dam impoundment at OLN12 (RM 4.50). Sediment chemical exceedances persisted through the lower mainstem and were accompanied by highly elevated DELTs, elevated maximum D.O, and elevated diel D.O. However, the attainment status was clearly WWH with some index values in the exceptional range similar to 2020.

The influence of flow modifications in the mainstem downstream from the Delaware Dam were not readily apparent in any of the biological or habitat indicators and the frequent spates during wetter summer-fall periods likely help to minimize effects from nutrients. Habitat was excellent at all except the impounded sites. This was evidenced in the nutrient box model results that were acceptable at the nine (9) sites at which Datasondes were deployed and continuous D.O. data was available.

The increased presence of multiple PAH compounds is a reflection of the increased urban runoff to the lower mainstem in Columbus and not necessarily a harbinger of impairment. All other parameters were in the good or excellent ranges and habitat was good and excellent at all except at the two impounded sites which were fair due to each being affected by low head dam impoundments.

The Dodridge Street and North Broadway dam pools are within the sole remaining MWH designated reach and both were in full attainment of MWH. Dodridge Street is now the downstream most, major impassable dam on the lower Olentangy River mainstem. The percentage of mayflies were low and very poor while the proportion of organic enrichment tolerant taxa were elevated and very poor. Habitat was rated as fair due to the impounded conditions.

Table 35. The status of aquatic life use attainment, biological criteria, habitat, biological response signatures, D.O. indicators of enrichment, and water and sediment chemical exceedances in the Olentangy River mainstem in 2022.

Site ID	River Mile Fish/Macroinvertebrates	Aquatic Life Use Status	IBI	ICI	MIwb	QHEI	Good QHEI Attributes	Poor QHEI Attributes	%DELTA	Sensitive Fish Species	%Mayflies	%Toxic Tolerant Taxa	%Organic Tolerant Taxa	Min. D.O. (mg/L)	Max. D.O. (mg/L)	Max. Daily D.O. Swing	Overall Nutrient Box Model Status	Water Column Poor/VP Exceedances	Sediment Chemical PEC/PEL Exceedances	Sediment PAH TEL/LEL Exceedances
Olentangy River - EWH (Existing)																				
OLN05	14.90/14.90	FULL	50	E	9.9	78.0	9	0	0.68	13.5	-	-	-	5.3	14.0	7.7	Acceptable	0	0	1
OLN07	12.90/13.30	PARTIAL	46	46	8.9 ^{ns}	76.5	8	3	1.18	15.0	10.0	0.1	13.8	6.6	10.7	3.9	Acceptable	1	0	0
OLN08	12.30/11.90	PARTIAL	46	38	8.5 ^{ns}	79.0	7	4	0.55	11.0	15.5	0.0	8.6	-	-	-	-	0	1	3
Olentangy River - WWH (Existing)																				
OLN09	8.50/8.50	FULL	50	34 ^{ns}	9.3	82.5	8	1	0.68	11.0	6.5	0.0	20.7	6.3	12.2	5.0	Acceptable	0	5	11
OLN10	7.10/7.00	FULL	50	38	9.4	82.5	9	1	2.19	10.0	13.7	0.0	8.0	6.0	12.0	4.6	Acceptable	0	5	11
Olentangy River - MWH-I (Existing)																				
OLN11	5.82/5.50	PARTIAL	32	20	7.3	54.5	4	6	5.45	5.0	19.9	0.0	20.3	4.0	11.5	7.3	Acceptable	0	4	5
OLN12	4.45/4.50	PARTIAL	38	20	7.9	58.0	4	7	1.46	6.0	0.3	0.0	52.6	4.8	12.0	4.6	Acceptable	1	5	10
Olentangy River - WWH (Existing)																				
OLN01	3.95/3.90	FULL	48	VG	10.2	78.8	8	1	3.17	16.0	-	-	-	7.0	11.4	3.0	Acceptable	0	6	11
OLN02	2.00/2.00	FULL	48	42	9.9	75.0	9	1	5.03	14.0	20.1	0.7	13.7	5.4	17.2	9.2	Acceptable	0	5	11
OLN03	1.80/1.70	FULL	48	38	10.4	85.3	9	1	3.86	14.0	20.7	0.0	15.9	-	-	-	Acceptable	0	5	10
OLN04	0.20/0.60	FULL	52	42	8.9	78.5	8	1	0.81	14.0	28.5	0.0	9.9	5.6	15.5	7.7	Acceptable	0	5	9
Narrative Threshold Rankings	Exceptional	FULL	44-60	≥42	≥9.1	>75	≥9	≤1	0.0	>15	>30	0.0	<5	-	-	-	Acceptable	0	0	0
	Good	FULL	38-43	32-40	8.0-9.0	60-74	≥6	≤4	<0.5	11-15	>20-30	<5	<15	>4	<12	<7.0	Acceptable	1	0	<4
	Fair	PART./NON	26-37	14-30	5.8-7.9	46-59	≥4	≤5	<3.0	3-10	>10-20	<20	>15	<4	>12	7.0-8.9	Enriched	2	1	<7
	Poor	NON-Poor	19-25	8-12	4.0-5.7	30-45	≥2	≥6	>10	1-2	>5-10	>35	>35	<2	>15	>9.0	Over Enriched	3	3	<10
	Very Poor	NON-V.Poor	12-18	0-6	<4.0	<30	<1	>7	>20	0.0	<5	<60	>60	-	-	-	-	4	5	≥10

RESULTS AND DISCUSSION – OLENTANGY RIVER TRIBUTARIES

Three Olentangy River tributaries were included in the 2020 survey and included Adena Brook (4 sites), Beechwold Run (1 site), and Rush Run (5 sites). Adena Brook and Rush Run were sampled to update the comparatively scant baseline data available at one or two sites close to the mouths of both in 1994 (Rush Run only), 1996 (Adena Brook only), and 1999 (Adena Brook and Rush Run). There is no historical data for Beechwold Run which is an unnamed and unlisted stream in the Ohio WQS. Adena Brook and Beechwold Run were included in 2020 because the former is within a Blueprint Columbus watershed where the effectiveness of green infrastructure installed between 2018-2021 (Columbus DOSD 2022) is being evaluated by The Ohio State University (OSU) in cooperation with DOSD. OSU has been actively monitoring storm sewer outfalls that drain the sewersheds within the Blueprint Columbus area in the Clintonville neighborhood (Smith et al. 2022). Beechwold Run serves as an untreated control for this aspect of that project. Rush Run was included in 2020 to provide a demonstration of assessing stormwater impacts via an integrated biological and water quality approach used across this survey and to update the impaired waters status at the request of the Friends of the Lower Olentangy Watershed (FLOW). Seven (7) additional tributaries were sampled in 2022 in order to assess the impacts of urban stormwater and SSOs in each and as pollutant delivery conduits to the Olentangy River mainstem. Several have not been monitored since 1999 and 2003.

Chemical/physical water quality in the 2022 Olentangy River Tributaries study area was characterized by grab sample data collected from the water column four times at each site during base flows and within a June 16-October 15 seasonal index period and at one site in each for sediment chemistry. Continuous measurements were not performed in these small headwater catchments. The chemical grab sampling results were evaluated by assessing exceedances of criteria in the Ohio WQS, by exceedances of regionally derived biological effect and reference thresholds (Ohio EPA 1999a, 2020; Miltner 2021) for parameters that lack formal criteria in the WQS. The chemical/physical results also serve as indicators of exposure and stress and in support of the biological data for assessing the attainment of aquatic life uses and assigning associated causes and sources for impairments. Bacteria data were collected by grab samples at all sites and were used primarily to determine the status of recreational uses in accordance with the Ohio WQS. Ohio EPA protocols for determining attainment of the applicable designated recreational use were followed.

Flow Regime

There were no direct or continuous measurements of flow in any of the Olentangy River tributaries that were sampled in 2022. As small headwater catchments draining less than 1-3 square miles the flow regime in each is subject to localized precipitation and runoff events. All of the tributaries have varying degrees of land use characteristics that can foster “flashy” flows that peak rapidly during runoff events interspersed with varying durations of low flow extremes during dry weather periods, in some cases including intermittent or ephemeral flows. These irregular flow conditions can also be exacerbated by direct habitat modifications that were especially evident in the upper reaches of Rush Run in 2020 (MBI 2022). Ohio EPA (2001) noted

that flow was substantial in Rush Run during the height of a “drought” in 1999. Most of the tributaries are nestled within steep ravines and in some like Adena Brook, with the substrates being comprised largely of bedrock that have shielded the channel habitat from direct encroachment and extensive modifications except for localized impacts at road crossings and roadside embankments. All of the tributaries receive stormwater from numerous storm sewers and most are affected by SSOs.

Pollution Sources

Pollution sources in all of the tributaries are typical of moderately to heavily urbanized watersheds consisting of urban runoff, illicit discharges, spills, and direct sources including storm sewer discharges and SSOs. Sewage can also enter stormwater from cross connections and inflow/infiltration from sanitary sewer lines. The latter is being addressed via Blueprint Columbus in Adena Brook in Clintonville (Columbus DOSD 2022).

Blueprint Columbus

The Clintonville Blueprint Columbus area located in north-central Columbus includes both the Clintonville main basin and Franklin main Walhalla basin for a total coverage of 3,552 acres. The area is bordered by Worthington to the north and by Glen Echo Park to the South. The western boundary of Clintonville is the Olentangy River, and the eastern boundary is the CSX railroad tracks and Interstate I-71. The entire length of the area is crossed by North High Street, which connects U.S. 23 to downtown Columbus. Overbrook Ravine, Whetstone Park, and the Park of Roses are located in the central portion of the Adena Brook watershed (Columbus DOSD 2015). Among the goals of the project are to reduce direct sanitary relief discharges (i.e., SSOs) and alleviate basement flooding. Judging by the *E. coli* results presented earlier in Table 6 (p. 21) and the chemical and biological data presented herein the presence of sewage in Adena Brook and other tributaries is a frequent occurrence. The effect of the tributaries on *E. coli* levels in the mainstem becomes more apparent downstream from the Rush Run confluence (RM 8.75) as evidenced in Figure 4 on p. 22.

Other Pollution Sources and Incidents

According to the most recent Ohio EPA survey of 2003 (Ohio EPA 2005), Adena Brook had two spills reported, one from a ruptured sewer line in 1996 and one from 4,500 gallons of vinegar discharged from the Marzetti food processing company in July 2001. This facility has an extensive history of non-permitted releases and spills of food-grade oil and/or vinegar to the creek over the past several decades (FLOW 2003). Ohio EPA records listed 10 spills or unpermitted wastewater discharges to storm sewers to Adena Brook between 1996 and 1998. A tributary to Adena Brook had a fish kill reported in 1999, although no source for the kill could be determined. Additional fish kills were documented in 1993 and 1996, the latter due to a sewer line breakage in Whetstone Park (Ohio EPA 2001). The 2003 survey report lists a sanitary sewage overflow as being located in the Park of Roses near the mouth. Besides the aforementioned reports of spills by local residents, the MBI fish crew observed and reported evidence of a recent spill event at the ADN02 site in July 2020 (MBI 2022), the source of which was never determined. Taken together the available information and observations back to 1999

suggest that Adena Brook is subjected to frequent discharge events and spills most of which are sewage related, but some of which are industrial in origin.

Other Olentangy River Tributaries

Eight other tributaries along the lower Olentangy River mainstem were included to provide new data of interest to local watershed interests and also as a demonstration of how ambient chemical, physical, and biological assessment can be used to assess the impact of stormwater and the MS4 program by extension. As with Adena Brook, these tributaries are impacted by the same types of urban sources such as urban runoff, storm sewer discharges, intermittent releases of sewage, and spills of both domestic and industrial origin. Turkey Run had two fish kills in 1993 and 1994 (Ohio EPA 2001). Bill Moose Run had two spills reported in 2004 (Ohio EPA 2005). While the earlier Ohio EPA reports did not report any spills or fish kills in the other tributaries it is likely that each is at least vulnerable to such events and it is likely that many events go unreported.

Olentangy River Tributaries Water Column Chemistry

Water quality was assessed by grab samples collected at all tributary sampling locations four times (meter parameters five times) during the summer-fall index period in 2022. Parameter groupings usually include field, demand, ionic strength, nutrients, and heavy metals. Sediment chemistry samples were collected at one location in each tributary in 2022. All of the data is analyzed in a tabular format with multiple sampling sites in the same stream arrayed from upstream to downstream in order to reveal pollution gradients. The most recent Ohio EPA surveys of Adena Brook and Rush Run were done in 1999 and 2003 (Ohio EPA 2001, 2005), the former with single sites near the mouth. These data were used for historical comparisons whenever feasible.

Conventional, Demand, and Nutrient Parameters

Conventional parameters include the most commonly collected parameters in water quality surveys such as temperature and pH, but these are covered under urban parameters. Demand and nutrient related parameters consist of those related to the discharges of treated and untreated sewage, organic enrichment from point and nonpoint sources, nutrient parameters and their effects, and physical parameters such as total suspended solids each being collected six (6) times during the summer-fall seasonal index period.

Ammonia-Nitrogen (N)

The Ohio water quality criteria are expressed as total ammonia-N with pH and temperature being the key variables used to determine how the total corresponds to the toxic unionized fraction. For the analysis of compliance with the Ohio water quality criteria, a series of combinations of pH and temperature values measured by grab samples were derived (Table 39). The analysis of the resulting total ammonia-N criteria values applicable to the Olentangy tributaries resulted in ammonia-N criteria for the WWH use designation in the tributaries varied between 0.60-0.80 mg/L as total ammonia-N (MBI 2022). Based on the U.S. EPA (2013) criteria

the resulting total ammonia-N was 0.63 mg/L for the Olentangy River tributaries (MBI 2022). The latter represents only a slight reduction in allowable total ammonia-N compared to the current Ohio WWH criteria.

Adena Brook and Rush Run 2022 Ammonia-N Results

The applicable ammonia-N criteria for WWH is 0.800 mg/L for Adena Brook and 0.600 mg/L for Rush Run based on the design pH and temperature values from grab samples (Table 38). The U.S. EPA criterion of 0.630 mg/L would apply only if mussels or snails were found to inhabit either stream based on the procedures in U.S. EPA (2013). All values in Adena Brook and Rush Run were below detection in all grab samples collected in 2020 and 2022 although the latter had detectable levels at upstream sites in 2020 (MBI 2022) that were not sampled in 2022.

Other Tributaries 2022 Ammonia-N Results

The mean ammonia-N in the Olentangy River tributaries in 2022 was below detection at all sites (Table 36). In selected tributaries this result was an improvement over the available 1999 results in which means were above detection, but no higher than 0.063 mg/L in Linworth Run. Means in Adena Brook and Rush Run were below the MDL in both 2020 and 2022.

Five-Day Biochemical Oxygen Demand (BOD₅)

Biochemical oxygen demand (BOD) measures the amount of oxygen consumption in mg O₂/L by the aerobic oxidation and consumption of organic matter primarily by bacteria. The higher the BOD the more rapidly D.O. is depleted in the water. The principal sources of BOD in small streams are organic matter including sewage, leaves, soils high in organic matter, woody debris, and dead and decaying algae. Expressed here as the five-day biochemical oxygen demand (BOD₅), this parameter has reflected the effectiveness of wastewater treatment at WWTPs throughout Ohio particularly in larger streams and rivers. While elevated BOD can reflect excessive inputs by point sources, the widespread control of this parameter by water quality based permitting and subsequent wastewater treatment has greatly reduced it as a major water quality concern in larger streams and rivers. In smaller headwater streams elevated BOD is a result of nonpoint source inputs and the indirect effects of flow and habitat alteration that exacerbate the effects particulate organic matter (McCabe et al. 2021), nutrients, and algal dynamics as they are affected by excessive nutrient enrichment (McCabe et al. 2021).

Adena Brook and Rush Run 2022 BOD₅ Results

Mean BOD₅ levels in Adena Brook were quite low being just above the MDL at all four sites in 2022 (Table 36). The very low values in 2020 and 2022 are consistent with the below detection levels of ammonia-N and low levels of TSS and suggests a low influence of organic materials either as a continuous presence or the retention of residual materials left from periodic inputs via urban runoff or stormwater. Rush Run had a mean value of 1.55 mg/L in 2022 which is a slight reduction from the 1.87 mg/L at the mouth site in 2020. Sites in upper Rush Run in 2020 were higher reflecting the organically enriched character of Rush Run coupled with the modified hydrology and habitat and higher inputs of organic materials (MBI 2022). Still, none of these levels were excessively high.

Table 36. Mean values for demand and nutrient related parameters in the Olentangy River tributaries in 1999/2020 and 2022. Bold italic values are the highest between the two years. Values are color coded in accordance with the legend at the bottom.

Site ID	River Mile	Drainage Area (mi. ²)	Ammonia- Nitrogen as Ammonia mg/L (Mean)		BOD 5 Day mg/L (Mean)		Kjeldahl- Nitrogen, Total as N mg/L (Mean)		Nitrate mg/L (Mean)		Nitrite mg/L (Mean)		Phosphorus Total as P mg/L (Mean)		Orthophosphate mg/L (Mean)		Total Suspended Solids (TSS) mg/L (Mean)		
			1999	2022	1999	2022	1999	2022	1999	2022	1999	2022	1999	2022	2020	2022	1999	2022	
Bartholomew Run																			
BAR01	0.2	1.13	0.050	0.014	2.08	1.55	0.30	0.48	0.58	0.85	0.02	0.01	0.054	0.240		0.06	11	12	
Linworth Run																			
LIN01	0.8	2.58	0.063	0.014	2.00	2.08	0.34	0.49	0.13	0.53	0.02	0.01	0.153	0.240		0.09	6	12	
Rush Run																			
RSH01	0.25	2.62	0.020	0.014	1.87	1.55	0.30	0.39	0.33	0.42	0.01	0.01	0.126	0.240	0.03	0.06	8	12	
Tributary to Olentangy River (RM 8.45)																			
TRIB01	0.1	1.08		0.014		1.58		0.28		0.60		0.01		0.240		0.06		12	
Tributary to Olentangy River (RM7.82) (Bill Moose Run)																			
BMR01	0.2	2.69	0.050	0.014	2.00	1.58	0.27	0.30	0.19	0.62	0.02	0.01	0.053	0.240		0.06	5	12	
Adena Brook																			
ADN04	1.6	1.80	0.020	0.014	1.30	1.43	0.33	0.39	0.68	1.01	0.03	0.01	0.076	0.240	0.10	0.12	3	12	
ADN03	1.0	2.28	0.020	0.014	1.30	1.43	0.30	0.39	0.51	0.89	0.03	0.01	0.069	0.240	0.06	0.10	4	12	
ADN02	0.7	2.66	0.020	0.014	1.30	1.55	0.33	0.32	1.23	1.98	0.03	0.01	0.076	0.240	0.12	0.11	7	12	
ADN01	0.2	2.71	0.020	0.014	1.30	1.55	0.31	0.42	0.50	0.81	0.03	0.01	0.069	0.240	0.05	0.07	4	12	
Turkey Run																			
TUR01	0.70	2.09	0.014	0.014	2.20	2.00	0.70	0.50	1.52	0.78	0.01	0.01	0.250	0.240		0.07	11	12	
Wahalla Hollow (Wahalla Ravine)																			
WAH01	1.0	1.13	0.057	0.014		1.58	0.51	0.23	1.78	0.91	0.01	0.01	0.344	0.240		0.19	2	12	
Glen Echo Ravine																			
GER01	1.0	0.6	0.527	0.014		1.58	0.50	0.38	1.36	1.25		0.01	0.182	0.240		0.06	2	12	
Large River Narrative Threshold Rankings	<50th Percentile		<0.025		<2.50 ^a		<0.40		<0.98		<0.01		<0.025		<0.15 ^d		<7		
	<75th Percentile		<0.050		<3.40 ^b		<0.60		<2.24		<0.03		<0.080		<0.30 ^d		<14		
	<90th Percentile		<0.100		<4.74 ^c		<1.03		<4.60		<0.05		<0.170		>0.30 ^d		<47		
	<95th Percentile		<0.184				<1.40		<5.98		<0.10		<0.307				<70		
	>95th Percentile		>0.184				>1.40		>5.98		>0.10		>0.307				<70		
	Ohio EPA 1999, ECBP			Ohio EPA 1999, ECBP		^a Miltner (2018); ^b Ohio EPA 1999 75th; ^c 95th			Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Miltner (2018)		Ohio EPA 1999, ECBP

Other Olentangy River Tributaries 2022 BOD₅ Results

Mean BOD₅ levels in the other tributaries were likewise quite low being just above the MDL at all of the other tributary sites with a high level of 2.08 mg/L in Linworth Run.

Total Kjeldahl Nitrogen (TKN)

Total organic nitrogen as measured by Total Kjeldahl Nitrogen (TKN), an indicator of the living or recently dead fraction of sestonic algae, can be an indicator of organic enrichment. While TKN is not a direct effect parameter, it is indicative of the effects of organic enrichment by nitrogenous biomass. It has proven to be an effective indicator of excessive organic enrichment in runoff from urban and suburban nonpoint sources. Miltner (2018) recognized TKN as a “stand alone” indicator of organic enrichment alongside BOD. In terms of assessment thresholds Miltner (2018) considered a TKN value of ≥ 0.75 mg/L to be indicative of over enriched conditions. MBI (2015) in a regional analysis of Southwest Ohio rivers and streams derived a TKN threshold of 1.05 mg/L for WWH and 0.30 for EWH boatable sites. Regional reference levels derived by Ohio EPA (1999a) for headwater streams in the ECBP ecoregion include a median of 0.40 mg/L and a statistical maximum of 1.40 mg/L.

Adena Brook and Rush Run 2022 TKN Results

Mean concentrations of TKN ranging from 0.28-0.34 mg/L in Adena Brook in 2020 were all below the median regional reference value that reflects a low level of nitrogenous biomass in that watershed (Table 36). The 2022 results were only slightly higher, but within the regional reference value. Mean TKN levels were likewise low at the mouth of Rush Run in 2022, but here again the upstream sites in 2020 were 0.71 mg/L and 0.61 mg/L which is almost double the values at the mouth site. These were the only two values that exceeded the median regional reference value and are due to the comparatively greater biomass of algae that was spurred by the lack of canopy, channel, and flow modifications in the upper reaches of Rush Run. Still, these are not particularly high TKN values even for an urban watershed (MBI 2022).

Other Olentangy River Tributaries 2022 TKN Results

Mean concentrations of TKN ranged from 0.23-0.50 mg/L in the other tributaries reflecting low inputs of nitrogenous materials.

Nitrate-Nitrogen (NO₃-N)

Nitrate as nitrogen is generally expressed as nitrate-N and along with nitrite-N comprises dissolved inorganic nitrogen in water. The mean values reported herein are nitrate-N plus nitrite-N, the latter of which was detected at low levels and in only about 10% of the samples collected in the study area. Nitrates are not toxic to aquatic life under normal concentrations, are a primary and essential plant nutrient, but can contribute to water quality problems in excessive amounts. Together with the other primary nutrient phosphorus, nitrates in excess amounts can stimulate excessive algal production leading and adverse effects to the D.O. regime that in turn can adversely affect aquatic life. Sources of nitrates in the Olentangy River tributaries include urban runoff and stormwater discharges. Assessment thresholds for nitrate-N are available as regional reference values of 0.98 mg/L (median) and 5.98 mg/L (95th

percentile) for headwater streams in the ECBP ecoregion and TMDL targets of 1.00 mg/L for WWH and 0.50 mg/L for EWH streams (Ohio EPA 1999a). The much higher 95th percentile value of 5.98 mg/L is undoubtedly influenced by headwater reference sites that have predominantly agricultural row cropping in their watersheds.

Adena Brook and Rush Run 2022 Nitrate-N Results

Nitrate-N levels ranged from 0.81-1.98 mg/L which is just below to just above the median reference benchmark (Table 36). Three of four sites in 2020 had nitrate-N levels less than 0.59 mg/L with the highest value of 1.40 mg/L occurring at ADN02 (RM 0.70) in 2020. This coincided with highly elevated TDS, conductivity, and zinc that were much higher than other sites in Adena Brook (MBI 2022). All of the Rush Run nitrate-N levels in both 2020 and 2022 were well below the regional reference median of 0.98 mg/L ranging from below detection to 0.59 mg/L at RSH03 (RM 1.90). The single site 2022 mean was 0.39 mg/L.

Other Olentangy River Tributaries 2022 Nitrate-N Results

Mean nitrate-N levels ranged from 0.42-1.25 mg/L which is well below to just above the median reference benchmark (Table 35). All means except for Glen Echo Ravine were well below the levels observed in Adena Brook in 2022, but were generally elevated compared to the 1999 results.

Total Phosphorus (P)

Phosphorus (P) is both an essential and limiting nutrient for plant growth and animal life. It is the most limiting nutrient in freshwater systems primarily to algal growth and biomass. Elevated levels of phosphorus under certain conditions can result in excessive algal growth and activity that in turn affects the D.O. regime and consequently aquatic life. Elevated levels can also stimulate the production of toxic algae that can impact human health, recreation, and public water supplies. In flowing water bodies such as rivers and streams the adverse impacts of elevated P are indirect via how it impacts algal activity and ultimately the D.O. regime. Algal photosynthesis produces oxygen during daylight while algal respiration uses oxygen at night. The difference between daytime and nighttime D.O. value is termed the diel swing the width of which is indicative of nutrient stimulated algal activity. This cycle also impacts pH (high daytime, low nighttime values) which in turn can impact the toxicity of ammonia especially at higher pH levels (i.e., >8.0). Thus the management of P loads from both point and nonpoint sources is an emerging water quality management issue. Sources of phosphorus in the Olentangy River tributaries primarily included urban runoff and sewage inputs via stormwater discharges and sewer overflows. The dynamics of how water quality and biological condition are affected by each is complex and related to physical factors such as flow (including retention time), habitat, and temperature (Ohio EPA 1999a; Miltner 2018). Assessment thresholds for total P are available as regional reference values of 0.025 mg/L (median) and 0.410 mg/L (statistical maximum) for headwater streams in the ECBP ecoregion and TMDL targets 0.08 mg/L for WWH and 0.05 mg/L for EWH headwater streams across Ohio (Ohio EPA 1999a).

Adena Brook and Rush Run 2022 Total P Results

Mean total P values were difficult to interpret in 2022 due to the high MDL of 0.240 mg/L so the orthophosphate levels were used. Total P ranged from 0.052-0.120 mg/L in Adena Brook in 2020 which are somewhat elevated considering the comparatively low values of the other organic enrichment and nutrient related parameter results (Table 36). Sources in Adena Brook are most likely from urban runoff, nutrient enriched stormwater inputs, and sewer overflows and general sewage contamination. Total P values in Rush Run were comparatively lower with values ranging from 0.016-0.050 mg/L in 2020 which is below the median and 75th percentile regional reference values (Table 35). Mean orthophosphate levels were highest in Adena Brook in 2022 ranging from 0.07-0.12 mg/L. Rush Run had a mean value of 0.06 mg/L all of which are comparatively low.

Other Olentangy River Tributaries 2022 Total P Results

Mean orthophosphate values were low ranging from 0.060-0.090 mg/L in all except Wahalla Hollow where a mean of 0.19 mg/L was observed (Table 36). None of these values suggest significant nutrient enrichment.

Total Suspended Solids (TSS)

Total suspended solids (TSS) are particles that are larger than 2 microns that occur in the water column. Anything that can pass through a 2 micron average filter size is considered a dissolved solid. TSS can include any particles drifting in the water column to include inorganic sediment, silt, and sand and organic matter such as plankton and algae. At typical ambient concentrations TSS has little or no direct effect on aquatic life. However, extremely high concentrations can be harmful to fish and invertebrate by clogging gills and smothering substrates. It is easy to measure and thus it is commonly employed as a singular indicator of nonpoint source pollution (MS4 stormwater permitting) despite its inherent variability and shortcomings as a reliable standalone indicator of impairment. Miltner (2018) included it as a large river nutrient effects parameter, but in a restricted role as a screening proxy parameter with >25 mg/L indicating enriched conditions when other indicators such as BOD₅ and TKN are not available. Regional reference TSS values for headwater streams in the ECBP ecoregion are a median of 7.0 mg/L and a 95th percentile of 69.95 mg/L.

Adena Brook and Rush Run 2022 TSS Results

Mean TSS values were extremely low in Adena Brook being well below the median regional reference value with all but one below the MDL in 2020 and 2022 (Table 36). The water column carries very little if any suspended material during normal summer-fall low flows, which made the turbidity resulting from the apparent spill in July 2020 that much easier to detect visually. It also indicates that clayey materials are low in the suspended solids that do exist in the water column since those materials are colloidal and stay in suspension for longer periods of time. Mean TSS values in Rush Run were similarly low in 2020 at all except the upstream most site RSH05 (RM 3.70) where the highest value among all tributary sites of 12.0 mg/L was measured (Table 35). This was the only TSS value that exceeded the regional reference median value of 7.0 mg/L. The 2022 result was 12 mg/L at the mouth.

Other Olentangy River Tributaries 2022 TSS Results

Mean TSS values were uniformly 12 mg/L in all other tributaries in 2022 which exceeded the regional reference median of 7 mg/L, but well within the 75th percentile reference value (Table 36).

Urban Parameters

Urban parameters include the common ions chloride and sulfate, conductivity, total dissolved solids, and common heavy metals such as copper, lead, and zinc. Total suspended solids can be included in this group because of its widespread use as an indicator of urban runoff and stormwater. Temperature and pH are generally considered to be conventional parameters, but in small urban watersheds they can be meaningful indicators of urban impacts. These parameters can become highly elevated in urbanized watersheds and are indicative of diverse sources and activities that exemplify urban land uses.

Temperature (°C)

Temperature is a critical factor in aquatic systems as it both directly and indirectly influences individual organism health and well-being and various physicochemical processes that also have direct and indirect effects. Fish will avoid lethal temperatures and will seek the temperature regime each species prefers. Temperature affects chemical rates and processes and the toxicity of certain pollutants (e.g., ammonia-N). While much of the concern with temperature has centered on discharges of heat, modifications and alterations to natural temperature regimes have received increased attention due to climate change.

Temperature was measured at all locations with the collection of each chemical grab sample and during each fish sampling event over the seasonal June-October index period. It was included as part of the urban influenced parameters (Table 37) as it can be affected by the interaction of several facets of urban land uses such as hardened surfaces, flow intermittency, exposure of the stream channel to full sunlight, and permitted and unpermitted discharges via storm sewers. The results were compared to the criteria in the Ohio WQS and regional reference values for headwater streams in the ECBP ecoregion (Ohio EPA 1999a).

Adena Brook and Rush Run 2022 Temperature Results

Summer season temperatures in Adena Brook in 2022 were generally elevated to above the median percentile regional reference temperature value. None were close to being exceedances of the Ohio WQS. Summer season results in Rush Run in 2020 showed that temperatures declined in a downstream direction, the opposite of what would be expected under normal circumstances. The temperature of 28.3°C at the upstream most site RSH05 (RM 3.70) downstream from E. Wilson Bridge Rd. exceeded the summer average criterion of 27.8°C and the next site downstream at site RSH04 (RM 3.00) at Shrock Rd. exceeded the 95th percentile reference value by 2.60°C. Further downstream at site RSH03 (RM 1.90), at the former Harding Hospital location, the temperature declined to 22.10°C and declined to 19.7°C at the downstream most site (RSH01, RM 0.25). The mean value in 2022 was 20.5°C. The 2020 results reflect the extensive channelization and likely relocation of upper Rush Run, the lack of a

Table 37. Mean values for urban related parameters in the Olentangy River tributaries in 1999/2020 and 2022. Bold italic values are the highest between the two years. Values are color coded in accordance with the legend at the bottom.

Site ID	River Mile	Drainage Area (mi. ²)	Temperature mg/L (Mean)		pH S.U. (Mean)		Chloride, Total mg/L (Mean)		Conductivity uS/cm (Mean)		Total Dissolved Solids mg/L (Mean)		Total Cu (Mean) ug/L		Total Zn (Mean) ug/L	
			1999	2022	1999	2022	1999	2022	1999	2022	1999	2022	1999	2022	1999	2022
Bartholomew Run RM (14.48)																
BAR01	0.2	1.13		20.4		8.05		66.25		859		475		5.6		19.7
Linworth Run (RM 9.99)																
LIN01	0.8	2.58		19.7		7.90		73.25		615		380		3.6		37.1
Rush Run (RM 8.75)																
RSH01	0.25	2.62	18.3	20.5	7.74	7.88	96.67	95.00	787	847	483	470	1.9	2.6	6.8	11.6
Tributary to Olentangy River (RM 8.45)																
TRIB01	0.1	1.08		18.0		7.88		73.50		811		405		5.5		24.3
Tributary to Olentangy River (RM 7.82) (Bill Moose Run)																
BMR01	0.2	2.69		20.5		8.13		61.50		739		448		2.9		7.8
Adena Brook (RM 6.00)																
ADN04	1.6	1.80	19.7	20.5	7.93	8.13	50.33	90.50	536	858	283	505	2.7	3.0	8.6	9.9
ADN03	1.0	2.28	20.0	21.4	7.89	8.05	37.00	79.25	453	756	253	483	2.6	2.8	4.6	11.6
ADN02	0.7	2.66	19.9	20.8	7.82	7.93	84.33	78.25	898	911	527	548	2.1	2.4	22.5	26.2
ADN01	0.2	2.71	19.7	20.3	7.96	7.95	40.00	76.75	472	864	267	460	2.7	3.2	4.3	8.3
Turkey Run (RM 5.82)																
TUR01	0.70	2.09		20.6		8.10		59.00		619		308		4.5		73.3
Wahalla Hollow (RM 4.52)																
WAH01	1.0	1.13		21.5		7.95		73.75		610		348		3.6		51.4
Glen Echo Ravine (RM 4.10)																
GER01	1.0	0.6		20.8		8.13		116.50		1080		613		2.7		26.5
Headwater Narrative Threshold Rankings	<50th Percentile		<19.0		<8.0		<17		<500		<397.5		ND		<5	
	<75th Percentile		<21.5		<8.1		<29		<558		<442.0		<5		<15	
	<90th Percentile		<23.0		<8.2		<77.3		<810		<476.7		<10		<25	
	<95th Percentile		<24.4		<8.3		<108		<914		<508.3		<15		<32	
	>95th Percentile		>24.4		>8.3		>108		>914		>508.3		>15		>32	
Source			Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP		Ohio EPA 1999, ECBP	

shading tree canopy, and periodic intermittent flows. The elevated temperatures at the two upstream sites would likely preclude certain sensitive headwater fish species and macroinvertebrate taxa that would be needed to meet the WWH biocriteria. All of Adena Brook and Rush Run at the mouth are adequately shaded by mature riparian canopies. None of these results suggest any issues with thermal modification with the exception of the Rush Run headwaters in 2020. There was insufficient temperature data in the Ohio EPA 1999 or 2003 survey data to make any conclusions about changes over time.

Other Olentangy River Tributaries 2022 Temperature Results

Summer season temperatures in the other tributaries in 2022 were generally lower or the same as Adena Brook (Table 37). Only the mean value of 21.5°C in Wahalla Hollow exceeded the 75th percentile reference value for ECBP headwater streams, but none approached the applicable summer average temperature criterion.

pH

pH is a measure of how acidic/basic water is with a measurement range of 0 to 14. It is a measure of the relative amount of free hydrogen (acidic) and hydroxyl (basic) ions in the water. pH is measured on a logarithmic scale where each number represents a 10-fold change in the acidity or basicness of the water. For example, water with a pH of five is ten times more acidic than water having a pH of six. It is an important factor in how chemicals affect aquatic life and other biological processes. It determines the solubility (amount that can be dissolved in the water) and biological availability (amount that can be utilized by aquatic life) of chemical constituents such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals (lead, copper, cadmium, etc.). For example, pH affects the amount of total ammonia-N that is present in the unionized and toxic form and along with temperature is part of the water quality criterion. At a temperature of 25°C, which is typical of summer ambient temperatures in the study area, a change in pH from 8.5 S.U. to 9.0 S.U. changes the equivalent ammonia-N criterion from 3.20 mg/L to 1.10 mg/L, a decrease of almost 66%. It also affects how much and what form of phosphorus is most abundant in the water, and therefore affects how aquatic plants and animals can utilize it. As a result pH is responsive to algal photosynthesis and respiration similar to D.O. with a diel cycle of pH being higher in daytime and lower at night. Along with hardness it affects the degree to which heavy metals are soluble which determines their toxicity. Reference pH values for small rivers in the ECBP ecoregion range between a median value of 8.2 S.U. and a statistical maximum of 8.4 S.U. The Ohio water quality criteria is expressed as a range of acceptable pH values between 6.5-9.0 S.U.

Adena Brook and Rush Run 2022 pH Results

pH values in Adena Brook and Rush Run were slightly elevated in 2022 compared to 2020 the regional reference median ranging from 7.88-8.13 S.U. (Table 37). These results do not suggest any issues with water quality related to pH including nutrient enrichment effects with only one mean value exceeding the 75th percentile regional reference value. pH values were highest in Rush Run at the two upstream most sites RSH04 and RSH05 in 2020 where the highest value of 8.46 S.U. at RSH04 (RM 3.00) exceeded the 95th percentile regional reference benchmark and

the RSH05 (RM 3.70) value of 8.25 S.U. nearly exceeded the 90th percentile benchmark. pH values at the next three sites downstream all were less than 8.00 and below the median regional reference value. The high values in the upper reach were indicative of nutrient enrichment effects that were likely exacerbated by the modified habitat and flow conditions (MBI 2022).

Other Olentangy River Tributaries 2022 pH Results

pH values in other tributaries were slightly elevated in 2022 above the 75th percentile regional reference value of 8.1 S.U. at three sites – Bill Moose Run, Turkey Run, and Glen Echo Ravine (Table 37). All other tributaries were well within the median reference value of 8.0 S.U.

Chlorides

In temperate climates such as exist in central Ohio, dissolved materials in the form of chlorides are an emerging problem because they accumulate in soils and shallow groundwater and have been documented to reach concentrations that can threaten and impair aquatic life. Of particular concern in urban areas with high road density is the concentration of chlorides from winter road salt applications and point source loadings from water treatment blowdown. Chlorides have been documented to be increasing steadily in freshwaters including large rivers (Mullaney et al. 2009; Kelly et al. 2012). Chlorides do not exhibit a simple runoff and export mode of effect, but rather accumulate in near surface groundwater (Kelly 2008), soils, and land surfaces adjacent to streams. Seasonal studies have shown that elevated summer concentrations are correlated with higher and acute concentrations during late winter and spring periods (Kaushal et al. 2005). Research in New England (Kaushal et al. 2005) and Minnesota (Novotny et al. 2008) show that chlorides can accumulate in watersheds and that there is a strong association between high winter and elevated summer concentrations. Novotny et al. (2008) identified that 78% of the road salt applied in a Minnesota watershed accumulated in a given year and contributed to an increase in summer chloride concentrations. Ohio does not have a chloride water quality criterion for the protection of aquatic life, although there is a maximum contaminant level of 250 mg/L that applies to public water supplies. U.S. EPA (1988) recommends a water quality criterion of 230 mg/L for the protection of aquatic life. A more recent Ohio study that examined several decades of ambient water quality data against biological assemblage response (Miltner 2021) recommends a “safe” level for chloride at 52 mg/L for the protection of high quality waters. This value is in line with a derived values of 52.6 mg/L for WWH and 21.9 mg/L for EWH attainment at headwater sites in Southwest Ohio (MBI 2015).

Adena Brook and Rush Run 2022 Chloride Results

Mean chloride values in 2022 were elevated more than two times at ADN03 (RM 1.00) and exceeding the 75th percentile reference values and the Miltner (2021) hazard level of 52 mg/L (Table 37). In 2020 mean values were comparatively lower at ADN03 (RM 1.00) below the median regional reference threshold for headwater streams. The other sites had values below the 90th percentile reference value of 77.3 mg/L. The highest value of 76 mg/L at site ADN02 (RM 0.70) exceeded the 52 mg/L hazard value of Miltner (2021) for Ohio streams. Neither the

two remaining Adena Brook sites ADN01 (RM 0.20) and ADN04 (RM 1.60) exceeded the hazard threshold. The 2020 values are low for such an urbanized watershed and it could be the bedrock substrate precludes long term storage as it does in streams with substrates of glacial and alluvial origin. The very upper portion of the Adena Brook watershed is crossed by major streets and I-71 each of which receive numerous applications of road salt each year. The mean chloride value in 2022 was 95 mg/L which exceeded the 90th percentile regional reference value of 77.1 mg/L. In 2020 mean values at all except the downstream most site (RSH01, RM 0.40) ranged from 110-120 mg/L. The downstream most site result of 96.7 mg/L exceeded the 90th percentile regional reference value and all sites exceeded the Miltner (2021) hazard value. The substrates in Rush Run are more amenable to retaining chlorides in the riparian zone and near surface ground water hence the higher summer results than in Adena Brook and all other tributaries except Glen Echo Ravine.

Other Tributaries 2022 Chloride Results

Mean chloride values in the other tributaries 2022 were generally lower than in Adena Brook with the exception of Glen Echo Ravine which had a mean of 116.5 mg/L that exceeded the 95th percentile regional reference value and more than two times the Miltner (2021) hazard level of 52 mg/L (Table 37).

Total Dissolved Solids

Total dissolved solids (TDS) is a measure of the dissolved content of all inorganic and organic substances present in water consisting of solids small enough to pass through 2-micron filter. While TDS is not generally considered to be a pollutant it can be useful as an aggregate indicator of the presence of a broad array of chemical pollutants. Common nonpoint sources of TDS in receiving waters are agricultural and urban runoff with parent geology and soils being important co-factors. Point sources of both industrial and municipal wastewater also influence TDS levels. The most common chemical constituents are calcium, phosphates, nitrates, sodium, potassium, and chloride, each of which can emanate from the aforementioned nonpoint and point sources. Total dissolved solids are differentiated from total suspended solids (TSS), in that the latter cannot pass through a 2 micron filter and are indefinitely suspended in solution. The Ohio TDS water quality criterion is 1500 mg/L. Regional reference values for headwater streams in the ECBP are a median of 397.5 mg/L and a 95th percentile value of 508.3 mg/L.

Adena Brook and Rush Run 2022 TDS Results

Mean TDS values in 2022 were almost double the 2020 results at three of the four sites with all exceeding the 90th percentile regional reference threshold of 508 mg/L. The 2020 means were below the median regional reference TDS value of 397.5 mg/L at all except the ADN02 (RM 0.70) site that had a TDS value of 520 mg/L (Table 37). The apparent background in Adena Brook was in the 220-260 mg/L range so this value was more than double that range suggesting an input via storm sewer(s) or an illicit discharge. The mean TDS value in Rush Run in 2022 was similar to the 2020 result. In 2020, TDS generally increased downstream being lowest and below the regional reference median value at RSH05 (RM 3.70) and exceeding the reference

75th percentile value at the downstream site RSH01 (RM 0.40; Table 36). These results were well within background levels especially within an urbanized watershed.

Other Olentangy River Tributaries 2022 TDS Results

Mean TDS values in the other tributaries in 2022 were lower than the regional reference median at three sites – Linworth Run, Turkey Run, and Wahalla Hollow (Table 37). Means exceeded the 75th percentile regional reference value of 442 mg/L at the remaining sites with the exception of Glen Echo Ravine which exceeded the 95th percentile regional reference value of 508 mg/L.

Specific Conductance

Specific Conductance is a measure of how effectively water conducts an electrical current. Conductance increases with an increasing amount and mobility of ions and is correlated with the dissolved solids content of water. The ions conduct electricity because they are negatively or positively charged when dissolved in water. As such conductance is an indirect measure of the concentration of dissolved ions in solution and is defined as the electrical conductance of 1 cubic centimeter (cm³) of a solution at 25°C. The Ohio WQS have a conductance criterion of 2400 µS/cm that is equivalent to the TDS criterion of 1500 mg/L. Regional reference conductance values for headwater streams in the ECBP ecoregion are a median of 500 µS/cm and a 95th percentile of 914 µS/cm.

Adena Brook and Rush Run 2022 Specific Conductance Results

The pattern of mean specific conductance values in Adena Brook in 2020 and 2022 tracked that exhibited by TDS with a high value of 911 µS/cm at ADN02 (RM 0.70) that exceeded the regional reference 90th percentile value with means at ADN01 and ADN04 also exceeding the 90th percentile value of 810 µS/cm (Table 37). Performing periodic conductivity surveys of Adena Brook under normal summer-fall flow conditions could reveal the source or sources of the highest TDS concentrations. In Rush Run the 2022 mean of 847 µS/cm was higher than in 2020. The 2020 mean specific conductance values followed the same pattern as TDS increasing in a downstream direction with values ranging from 660-760 µS/cm all of which exceeded the 75th percentile regional reference benchmark of 558 µS/cm (Table 36). These values, while in the upper one-half of regional reference range of specific conductance, are lower than what can be measured in many urbanized headwater streams of a similar size.

Other Tributaries 2022 Specific Conductance Results

The pattern of mean specific conductance values in the other tributaries generally tracked the TDS results except that several values eclipsed the 75th percentile regional reference value of 810 µS/cm (Table 37). The highest value of 1080 µS/cm among all tributary locations was recorded in Glen Echo Ravine which exceeded the 95th percentile reference value of 914 µS/cm.

Copper and Zinc

Copper and zinc are two heavy metals that are frequently detected in urbanized watersheds. Mean copper values were less than the 75th percentile reference value of 5 µg/L in 2022 at all

except two sites which barely exceeded that threshold (Table 37). The Adena Brook and Rush Run results were similar between 2020 and 2022. None of these levels pose any threat to aquatic life, but are indicative of urban runoff.

Mean zinc values between tributaries exhibited a wider range in 2022 with three tributaries – Linworth Run, Turkey Run, and Wahalla Hollow – exceeding the 95th percentile regional reference value of 32 µg/L (Table 36). Mean values were lowest in Adena Brook, Rush Run, and the Tributary at RM 8.45 all below the 75th percentile regional reference value of 15 µg/L. The remaining tributaries had means that exceeded the 90th percentile regional reference value of 25 µg/L. Again, these do not necessarily pose a threat to aquatic life, but are indicative of urban runoff above representative regional reference levels.

Heavy Metals and Organic Compounds

Heavy metal and organic compounds in water are generally regarded as indicators of acute and chronic toxicity that were readily detectable at harmful amounts prior to the mandating of controls for point sources by the 1972 CWA and thereafter from other sources via other laws and regulations. Since the development of water quality based limitations in NPDES permits and the general cleanup of other sources of metal and organic contaminants, measuring concentrations and even detecting metals and some organics in the water column has become rare to non-existent. Analyzing for metals and organic compounds in sediments has been emphasized more as these compounds have been at or below detection in the water column. Sediments can retain these compounds longer and likely represent a longer term measure of the true levels of contamination by these compounds.

Water Column Metals

Heavy metals analyzed in grab water samples included arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), nickel (Ni), lead (Pb), silver (Ag), and zinc (Zn) in their total recoverable state (Table 38). Hardness was calculated from the measured concentrations of magnesium (Mg) and calcium (Ca) to determine the hardness dependent water quality criteria for each heavy metal at each site. Hardness levels ranged from a low of 185 mg/L in Wahalla Hollow to a high value of 388 in Adena Brook at ADN02 (RM 0.7). None of the nine (9) heavy metal parameters had any exceedances of the chronic outside mixing zone maximum (OMZM) or average (OMZA) criteria at the average hardness measured in 2022. All metals including iron (Fe) had measured levels that were an order of magnitude or more below the water quality criteria with no distinct patterns related to any sources. Only copper and zinc exhibited patterns suggestive of urban influences.

Sediment Metals

Metals in sediment were analyzed for the same seven (7) parameters as in the water column (Table 39). The results were compared to Ohio EPA Sediment Reference Values (SRV; Ohio EPA 2008) and the Probable Effect Concentration (PEC) and Threshold Effect Concentration (TEC) levels of MacDonald et al. (2000). The PEC means that most species and taxa may be adversely affected whereas the TEC means that the most sensitive species and taxa may be affected.

Table 38. Mean values for water column heavy metals in the Olentangy River tributaries in 1999/2020 and 2022. Bold italic values are the highest between the two years. Values are color coded in accordance with the legend at the bottom.

Site ID	River Mile	Drainage Area (mi. ²)	Hardness mg/L		Arsenic ug/L		Cadmium ug/L		Chromium ug/L		Copper ug/L		Iron ug/L		Lead ug/L		Nickel ug/L		Silver ug/L		Zinc ug/L	
			2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022
Bartholomew Run																						
BAR01	0.2	1.13	--	273	--	1.45	--	0.05	--	0.61	--	5.58	--	250	--	0.34	--	4.63	--	0.03	--	19.68
Linworth Run																						
LIN01	0.8	2.58	--	218	--	1.90	--	0.03	--	1.28	--	3.63	--	168	--	0.20	--	3.43	--	0.03	--	37.13
Rush Run																						
RSH01	0.25	2.62	305	258	1.02	1.23	0.04	0.05	--	0.86	1.85	2.60	265	258	0.28	0.28	4.60	4.25	--	0.03	6.75	11.60
Tributary to Olentangy River (RM 8.45)																						
TRIB01	0.1	1.08	--	--	--	1.06	--	0.04	--	1.05	--	5.53	--	49	--	0.24	--	3.33	--	0.03	--	24.30
Tributary to Olentangy River (RM7.82) (Bill Moose Run)																						
BMR01	0.2	2.69	--	230	--	1.30	--	0.04	--	0.68	--	2.88	--	139	--	0.36	--	3.88	--	0.03	--	7.75
Adena Brook																						
ADN04	1.6	1.80	205	295	1.50	1.60	0.04	0.05	--	0.79	2.65	2.98	115	95	0.28	0.27	3.10	4.25	--	0.03	8.60	9.93
ADN03	1.0	2.28	280	288	1.50	1.53	0.04	0.05	--	0.66	2.60	2.78	68	69	0.14	0.32	3.30	4.18	--	0.03	4.55	11.55
ADN02	0.7	2.66	335	338	0.89	0.62	0.04	0.04	--	0.60	2.05	2.43	135	100	0.70	0.67	4.75	5.38	--	0.03	22.50	26.23
ADN01	0.2	2.71	190	278	1.15	1.35	0.03	0.04	--	0.51	2.70	3.20	110	63	0.15	0.19	3.45	4.33	--	0.03	4.25	8.33
Turkey Run																						
TUR01	0.70	2.09	--	233	--	1.75	--	0.03	--	0.88	--	4.53	--	71	--	0.19	--	3.75	--	0.03	--	73.25
Wahalla Hollow (Wahalla Ravine)																						
WAH01	1.0	1.13	--	185	--	1.28	--	0.05	--	0.95	--	3.63	--	65	--	0.48	--	3.38	--	0.03	--	51.38
Glen Echo Ravine																						
GER01	1.0	0.6	--	343	--	1.53	--	0.06	--	0.81	--	2.68	--	128	--	0.33	--	4.95	--	0.03	--	26.53
Ohio WQS for Aquatic Life			<OMZA ¹		<150		<4.8		<19.4		<1000		<19		<107				<246			
			≥OMZA ¹		≥150		≥4.8		≥19.4		≥1000		≥19		≥107				≥246			
			≥OMZM ¹		≥340		≥11.8		≥27				≥363		≥966				≥246			
			≥IMZA ¹		≥680		≥23.7		≥62.6				≥726		≥1931				≥494			

¹Ohio water quality criteria for aquatic life at a hardness of 235 mg/L; OMZA-Outside Mixing Zone Average; OMZM-Outside Mixing Zone Maximum; IMZM-Inside Mixing Zone Maximum

Table 39. Concentrations of selected heavy metals in bulk sediment samples collected at 11 ambient locations in the Olentangy River mainstem in October 2022. The Ohio EPA sediment reference values (SRV) and MacDonald et al. (2000) threshold effect (TEC) and probable effect (PEC) thresholds are indicated at the bottom of the table.

Site ID	River Mile	Drainage Area (mi. ²)	Arsenic (mg/kg)	Cadmium (mg/kg)	Copper (mg/kg)	Chromium (mg/kg)	Iron (mg/kg)	Nickel (mg/kg)	Lead (mg/kg)	Zinc (mg/kg)	Detects	Exceed-ances
Bartholomew Run (RM 14.48)												
BAR01	0.2	1.13	28.0	0.34	24	12.7	27000	30	54	92	8	3
Linworth Run (RM 9.99)												
LIN01	0.8	2.58	12.0	0.44	17	9.7	13000	18	13	65	8	1
Rush Run (RNM 8.75)												
RSH01	0.25	2.62	22.0	0.61	38	17.9	25000	37	36	206	8	5
Tributary to Olentangy River (RM 8.45)												
TRIB01	0.1	1.08	17.0	0.24	18	8.0	17000	19	12	120	8	1
Tributary to Olentangy River (RM 7.82) (Bill Moose Run)												
BMR01	0.2	2.69	16.0	0.47	22	11.7	20000	24	25	140	8	4
Adena Brook (RM 6.00)												
ADN01	0.2	2.71	16.0	0.42	28	12.0	19000	25	32	144	8	4
Turkey Run (RM 5.82)												
TUR01	0.70	2.09	14.0	0.35	25	11.6	16000	24	18	110	8	2
Wahalla Hollow (RM 4.52)												
WAH01	1.0	1.13	22.0	1.00	49	33.7	27000	40	130	530	8	6
Glen Echo Ravine (RM 4.10)												
GER01	1.0	0.6	21.0	0.99	46	41.1	33000	35	86	440	8	7
Ohio EPA		SRV	25.1	0.8	33	40	51000	61	47	170		
MacDonald et al. (2000)		PEC	33.0	5	--	43.4	--	49	128	459		
		TEC	9.8	0.99	32	111	--	23	23	121		

There were two exceedances of the more serious PEC threshold both in Wahalla Hollow for lead and zinc. There were a total of nine (9) exceedances of the TEC threshold for arsenic, copper, chromium, lead, and zinc. Glen Echo Ravine had four (4) TEC exceedances of copper, chromium, lead, and zinc. Bartholomew Run and Rush Run had two TEC exceedances each with a single TEC exceedance in Wahalla Hollow to go with the two PEC exceedances. While metals were detected in each sample, the majority had values less than the TEC or SRV levels. The preponderance for PEC, TEC, and SRV exceedances was in the most urbanized lower tributaries, a reflection of the most likely source of these compounds.

Sediment Organics

Organic chemicals in sediment were analyzed for polycyclic aromatic hydrocarbon (PAH) and semi-volatile organic compounds. Of the nine semi-volatile organic compounds that were analyzed only two, methylene chloride and acetone at two and one site, respectively were detected in 2022. These were all low risk exceedances using thresholds cited in Buchman (2008) (Table 40). Most of these compounds are common by products of various manufacturing processes and the likely source is urban runoff.

Polycyclic Aromatic Hydrocarbon (PAH) compounds are more commonly detected in sediment samples especially in urban areas. All of the detected PAH compounds are by products of coal tar, gasoline exhaust, and incomplete combustion and several are known carcinogens. Most of these compounds are not manufactured and are more commonly detected in urban rivers and streams with runoff from asphalt pavement and heavy automobile traffic as the primary sources.

All of the 11 PAH compounds that were analyzed for were detected in the Olentangy River tributaries. Only one PAH compound, fluoranthene, was detected in every tributary. The other compounds were detected at varying number of sites (Table 40). There were 38 exceedances of the PEC/SEL threshold of MacDonald et al. (2000) PEC or Persaud et al. (1993) severe (SEL) effect thresholds among all nine tributaries. Exceedances of the lesser threshold (TEC) and low effect (LEL) thresholds numbered 19. The exceedance of thresholds and concentrations of PAH compounds was the most frequent in Wahalla Hollow (7 PEC and 4 TEC), Adena Brook (6 PEC and 4 TEC), Glen Echo Ravine (6 PEC and 4 TEC), Linworth Run (5 PEC and 2 TEC), Rush Run (5 PEC and 2 TEC), Turkey Run (5 PEC and 1 TEC), Bill Moose Run (3 PEC and 2 TEC), and Bartholomew Run (1 PEC and 0 TEC). Only the Tributary at RM 8.45 had no exceedances. While the detections of PAH compounds are an indication of the increased delivery of these contaminants to Olentangy River tributaries. There was an apparent tendency for the frequency and severity of the exceedances and total mass of PAH compounds to occur in the downstream tributaries although this urban footprint occurred as far upstream as Linworth Run.

Physical Habitat for Aquatic Life

The physical habitat of a stream or river is a primary determinant of biological quality and potential. Rivers and streams in the glaciated Midwest, left in their natural state, typically offer pool-run-riffle sequences, moderate to high sinuosity, and well-developed channels with deep

Table 40. Concentrations of semi-volatile organic compounds in bulk sediment samples collected at 11 ambient locations in the lower Olentangy River mainstem in October 2020 and 2022. Threshold exceedances are color coded with values in the footnotes. Values in blank cells were below the MDL.

Site ID	River Mile	Drainage Area (mi. ²)	Methylene Chloride (mg/kg)	bis(2-Ethylhexyl)phthalate (mg/kg)	4-Methylphenol (mg/kg)	Dibenzofuran (mg/kg)	Acetone (mg/kg)	Benzoic Acid (mg/kg)	Carbazole (mg/kg)	Benzyl Alcohol (mg/kg)	Butyl Benzyl Phthalate (mg/kg)	Pyridine (mg/kg)
Bartholomew Run												
BAR01	0.2	1.13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Linworth Run												
LIN01	0.8	2.58	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Rush Run												
RSH01	0.25	2.62	ND	ND	ND	ND	4.80	ND	ND	ND	ND	ND
Tributary to Olentangy River (RM 8.45)												
TRIB01	0.1	1.08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tributary to Olentangy River (RM7.82) (Bill Moose Run)												
BMR01	0.2	2.69	2.50	ND	ND	ND	ND	ND	ND	ND	ND	ND
Adena Brook												
ADN01	0.2	2.71	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Turkey Run												
TUR01	0.70	2.09	3.00	ND	ND	ND	ND	ND	ND	ND	ND	ND
Wahalla Hollow (Wahalla Ravine)												
WAH01	1.0	1.13	ND	ND	ND	ND	ND	ND	3.70	ND	ND	ND
Glen Echo Ravine												
GER01	1.0	0.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Key	Low Risk		2.00 ^d	0.18 ^c	0.67 ^c	0.415 ^c	0.04 ^e	0.65 ^c			0.10 ^b	0.10 ^b
	High Risk					5.1 ^a						0.50 ^b
^a NOAA SQUIRT Guides <i>Hyalella azteca</i> bioassay threshold ("lowest reliable target"). ^b NOAA SQUIRT Guides: Dutch Sediment Serious Contamination Levels "Target vs. Intervention." ^c EPA Region III BTAG, Freshwater Sediment Screening Benchmarks (Risk Comparison Values), 8/2006 ^d Ecological Screening Values for Surface Water, Sediment, and Soil by G. P. Friday (WSRC-TR-98-00110); intervention value (MHSPE 1994) divided by a factor of 10 ^e U.S. EPA. 2015. Region 4 Ecological Risk Assessment Supplemental Guidance												

Table 41. Concentrations of polycyclic aromatic hydrocarbon (PAH) compounds in bulk sediment samples collected at nine (9) ambient locations in the Olentangy River mainstem in October 2022 with exceedances of Low and Threshold Effect (LEL, TEC) and Severe and Probable Effect (SEL, PEC) color coded. ND in cells are below the MDL for that compound.

Site ID	River Mile	Drainage Area (mi. ²)	Anthracene (mg/kg)	Benzo(ghi)perylene (mg/kg)	Indeno(1,2,3-c,d)pyrene (mg/kg)	Phenanthrene (mg/kg)	Benzo(a)Anthracene (mg/kg)	Benzo(k)fluoranthene (mg/kg)	Benzo(a)pyrene (mg/kg)	Chrysene (mg/kg)	Benzo(b)fluoranthene (mg/kg)	Pyrene (mg/kg)	Fluoranthene (mg/kg)	Total PAH (mass) 1999	Total PAH (mass) 2022
Bartholomew Run (RM 14.48)															
BAR01	0.2	1.13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.200		1.200
Linworth Run (RM 9.99)															
LIN01	0.8	2.58	ND	ND	ND	3.200	2.600	1.500	3.100	3.800	ND	6.100	8.200		28.500
Rush Run (RM 8.75)															
RSH01	0.25	2.62	ND	ND	ND	4.400	2.800	1.200	3.000	3.800	ND	6.500	9.100		30.800
Tributary to Olentangy River (RM 8.45)															
TRIB01	0.1	1.08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		0.000
Tributary to Olentangy River (RM 7.82) (Bill Moose Run)															
BMR01	0.2	2.69	ND	ND	ND	1.100	ND	ND	1.100	1.400	ND	2.100	2.700		8.400
Adena Brook (RM 6.00)															
ADN01	0.2	2.71	ND	2.000	2.900	3.000	2.100	2.000	3.300	3.800	2.800	5.300	7.300		34.500
Turkey Run (RM 5.82)															
TUR01	0.70	2.09	ND	ND	ND	1.500	1.400	ND	1.600	2.100	ND	3.200	4.100		13.900
Wahalla Hollow (RM 4.52)															
WAH01	1.0	1.13	2.400	3.200	4.800	18.000	17.000	10.000	16.000	19.000	15.000	33.000	43.000		181.400
Glen Echo Ravine (RM 4.10)															
GER01	1.0	0.6	0.720	1.400	2.800	ND	3.500	2.700	4.300	5.300	3.800	5.500	13.000		43.020
MacDonald et al. (2000) Thresholds	PEC		≥0.845	--	--	≥1.170	≥1.050	--	--	1.290	--	1.520	2.230		
	TEC		≥0.057	--	--	≥0.204	0.108	--	--	0.166	--	0.195	0.423		
Persaud et al. (1993) Thresholds	SEL		>370	>320	>320	>950	>1480	>1340	>1440	>460	>1340	>850	>1020	>10,000	>10,000
	LEL		>0.220	>0.170	>0.200	>0.560	>0.320	>0.240	>0.370	>0.340	>0.240	>0.490	>0.750	>4,000	>4,000

pools, heterogeneous substrates, and cover in the form of woody debris, hard substrates, and aquatic macrophytes. The Qualitative Habitat Evaluation Index (QHEI) categorically scores basic components of stream and riverine habitat into ranks according to the degree to which those components are found compared to a natural state, or conversely, in an altered or modified state. In the middle Scioto River study area, QHEI scores and physical habitat attributes were recorded in conjunction with the fish sampling conducted at each site. QHEI scores >55 are generally regarded as having the potential to support attainment of the WWH aquatic life use designation and scores >70 indicate excellent habitat in headwater streams. Conversely scores less than 55 have an increasingly limited potential to support WWH and scores less than 45 indicate low or no ability to attain WWH, thus interventions to improve the QHEI scores would be needed. Rankin (1989, 1995) developed a matrix of QHEI attributes that include good attributes that enhance physical habitat and modified attributes that deter attainment of WWH. Generally ratios of modified to good attributes of >2.0 indicate that altered habitat is a deterrent to attaining WWH.

In small, urbanized headwater streams such as the Olentangy River tributaries the principal impacts to instream and riparian habitat are from adjacent land uses, hydrological modifications including flashy flows and flow intermittency, and the direct modification of the stream channel, instream cover, and substrates, the latter resulting from excessive embeddedness where fines such as clayey silts and sand can fill the interstices formed by larger substrate types such as large gravel, cobbles, and boulders. All of the tributaries are nestled in wooded ravines to varying degrees with the stream channel bordered by small roads and bank stabilization structures, but most of the instream habitat being composed of bedrock and larger substrates has resulted in the stream channels being mostly intact.

2022 QHEI Results

Habitat as measured by the QHEI in the lower Olentangy River tributaries in 2020 was used to develop a matrix of good and modified habitat attributes (after Rankin 1995) for each site in the Olentangy River tributaries study area (Table 42). The matrix includes an accounting of the number good and modified habitat attributes (Rankin 1989, 1995) and their ratio. Modified attributes are subdivided between high and moderate influence as defined by Rankin (1989) based on an analysis of the Ohio statewide database. The analysis was detailed for the headwater site type, i.e., sites with drainage areas <20 mi.².

Adena Brook and Rush Run 2022 Habitat Results

QHEI scores in Adena Brook in 2022 were excellent at two sites (ADN04 and ADN01) and good at the other two sites (ADN02 and ADN03) the same as in 2020 (Table 42). Three sites had a good or excellent number of good attributes while ADN02 had a fair number of good attributes. ADN02 was the only site with a high influence modified attributes (sparse/no cover and maximum depth <40 cm). Sites ADN04 and ADN02 had three (3) and five (5) moderate influence modified attributes (fair), while site ADN03 had five (5; fair) and site ADN01 three (3; good). None of these results indicate that habitat alone is precluding the attainment of the WWH biocriteria at any Adena Brook site. The single Rush Run site in 2022 scored an excellent

Table 42. Qualitative Habitat Evaluation Index (QHEI) scores showing good and modified habitat attributes at sites in the Olentangy River tributaries in 2022. Narrative ratings and color coding in legend at bottom of table based on the headwater site type.

Site ID	River Mile	QHEI	Good Habitat Attributes										High Influence Modified Attributes					Moderate Influence Modified Attributes							Poor Habitat Attributes	Ratio of Modified (High) to Good	Ratio of Modified (All) to Good					
			No Channelization	Boulder, Cobble, Gravel	Silt Free	Good-Excellent Development	Moderate-High Sinuosity	Moderate-Extensive Cover	Fast Flow w Eddies	Little to No Embeddedness	Max Depth > 40 cm	No Riffle Embeddedness	Good Habitat Attributes	No Recovery from Channelization	Silt/Muck Substrates	No Sinuosity	Sparse No Cover	Max Depths <40 cm	High Influence Poor Attributes	Recovering from Channelization	Mod-High Silt Cover	Sand Substrates (Boatable sites)	Hardpan Origin	Fair- Poor Development				Low Sinuosity	<2 Cover Types	Intermittent Flow or Pools <20 cm	No Fast Current Types	Mod-Extensive Embeddedness
Bartholomew Run (RM 14.48)																																
BAR01	0.20	63.5	■	■		■	■		■	■	■	7					0	●			●									3	0.00	0.43
Linworth Run (RM 9.99)																																
LIN01	0.80	63.0		■					■			4			●		1	●			●	●							4	0.25	1.25	
Rush Run (RM 8.75)																																
RSH01	0.24	72.0	■	■		■	■	■	■	■	■	8					0	●				●							3	0.00	0.38	
Tributary to Olentangy River (RM 8.45)																																
TRIB01	0.10	65.5	■	■			■	■	■	■	■	7					0				●								2	0.00	0.29	
Tributary to Olentangy River (RM7.82) (Bill Moose Run)																																
BMR01	0.20	70.5		■	■			■	■	■	■	5				●	1	●			●	●							4	0.20	1.00	
Adena Brook (RM 6.00)																																
ADN04	1.70	76.0	■	■		■	■	■	■	■	■	8					0	●				●							3	0.00	0.38	
ADN03	0.80	60.5		■	■				■	■	■	5					0	●				●	●						5	0.00	1.00	
ADN02	0.52	57.3		■	■				■	■	■	4			●	●	2	●				●	●						5	0.50	1.75	
ADN01	0.23	75.5	■	■	■	■	■	■	■	■	■	8					0				●								3	0.00	0.38	
Turkey Run (RM 5.82)																																
TUR01	0.70	69.5		■				■	■	■	■	5					0	●			●	●							4	0.00	0.80	
Wahalla Hollow (RM 4.58)																																
WAH01	1.00	47.0		■				■	■	■	■	3				●	2	●				●							4	0.67	2.00	
Glen Echo Ravine (RM 4.10)																																
GER01	0.95	57.0		■			■	■	■	■	■	6					0	●				●							4	0.00	0.67	
QHEI Narrative	Excellent	>70										>8					0												<1	<0.20	<0.50	
	Good	>55										>6					0													<4	<0.50	<2.00
	Fair	>43										>3					1													<5	>1.00	>2.00
	Poor	>30										>2					2													>6	>2.00	>6.00
	Very Poor	<30										<1					3													>7	>4.00	>10.00

eight (8; excellent) and RSH05 had the lowest at one (1; very poor). QHEI with eight (8; excellent) and three (3; good) modified attributes. In 2020 the multiple sites had widely variable habitat quality with good QHEI scores at RSH01 (RM 0.24; 69.5), RSH02 (RM 1.03; 57.5), and RSH03 (RM 1.90; 57.0), a fair QHEI at RSH04 (RM 2.90; 50.0), and a very poor QHEI score at RSH05 (RM 3.55; 26.5). RSH01 had the highest number of good attributes at Site RSH05 (RM 3.55) had three (3) high influence modified attributes (very poor) and six (6) moderate influence modified attributes (poor). The high influence attributes were no recovery from channelization, silt/muck substrates, and maximum pool depth <40 cm. Site RSH04 (RM 2.90) had two (2) high influence (poor) and seven (7) moderate influence modified attributes (very poor). The two high influence attributes were sparse/no cover and maximum pool depths <40 cm. Site RSH03 (RM 1.90) also had the same two (2) high influence modified attributes (poor), but only three (3) moderate influence modified attributes (good). Site RSH02 (RM 1.03) had a single (1) high influence modified attribute and four (4) moderate influence modified attributes (good). Site RSH01 (RM 0.24) had only four (4) moderate influence modified attributes (good). The modified:good ratio (all modified attributes included) was greater than 2.00 at RSH05 (RM 3.55) with 9.00 (poor) and site RSH04 (RM 2.90) with a ratio of 2.25 (fair). All of the other sites in Rush Run had ratios of 1.00 or less. The only site where WWH is potentially precluded by habitat alone is RSH05 with RSH04 having marginal habitat to support WWH. Flow intermittency is also an issue at RSH05 as it was too shallow to sample macroinvertebrates in 2020. Direct intervention would be required to mitigate the heavily degraded habitat.

Other Olentangy River Tributaries 2022 Habitat Results

QHEI scores in the other tributaries in 2022 (Table 42) ranged from excellent in Bill Moose Run (QHEI = 70.5), good at all other tributaries, and fair in Wahalla Hollow (QHEI = 47.0). High influence poor attributes due to depths less than 40 cm occurred in Linworth Run and Bill Moose Run. Wahalla Hollow had two high influence modified attributes, depths less than 40 cm and sparse or no cover. Poor attributes numbering 2-4 were all in the good range. The number of good attributes were mostly fair numbering 3-5 with a good result Bartholomew Run and the Tributary at RM 8.45. None of the sites had good:poor ratios outside the good range. There was a pattern of tributaries in the more developed lower tributaries having the highest number of poor attributes and lower QHEI scores. Some are marginal enough to preclude WWH and when the lack of connectivity to the mainstem is added both Wahalla Hollow and Glen Echo Ravine have very low potential to improve without significant intervention.

Biological Assemblages – Fish

The fish assemblages of the Olentangy River tributaries has been assessed in the prior years, of 1994, 1996, 1999, and 2003. The 2020 sampling in Adena Brook and Rush Run are the most complete surveys conducted to date. Most of the remaining tributaries were assessed in 1999 or 2003 by Ohio EPA. This analysis focuses on the 2022 results and what the new data adds to the understanding of the quality and condition of the fish assemblages in these small, urbanized head water streams. An assessment of historical trends is limited by the span of the historical data and the few sites that were assessed in 1994, 1996, 1999, and 2003. Summarized data tables for 2022 appears in Appendix B.

2022 Fish Assemblage Results

A total of 112 native species among 3,696 fish counted were collected from the nine Olentangy River tributaries in 2022 (Appendix B). Creek Chub (*Semotilus atromaculatus*) was the most common species comprising 48.8% by numbers and occurring in seven (6) of the nine (9) tributaries. Western Blacknose Dace (*Rhinichthys obtusus*) was the next most numerous species comprising 25.5% by numbers followed by Green Sunfish (*Lepomis cyanellus*) at 12.0% and Central Stoneroller (*Campostoma anomalum*) at 6.7%. The remaining seven (7) species comprised 2.7% by numbers. Four (4) out of the top five (5) species are highly tolerant with two moderately tolerant species that were represented by 14 and 10 individuals, respectively, and the remaining five (5) species being intermediate. Species such as Creek Chub and Western Blacknose Dace are common in small headwater streams with the latter an indication of permanent flow, but several of the other species can be transient in flow variable streams. On the positive side there were 14 Rainbow Darters (*Etheostoma caeruleum*), a moderately intolerant species and 10 Golden Redhorse (*Moxostoma erythrurum*) that is also an indicator of permanent flow.

To evaluate the overall quality of the fish assemblages and to gauge attainment of the numerical biological criteria the IBI derived and calibrated for headwater streams draining <20 mi.² was used. Other fish metrics were also examined including the number of native species, %DELT anomalies, the number of sensitive fish species, the %simple lithophils, and %tolerant fish were also examined for each site to gauge the response types exhibited by the fish assemblage (Table 42).

Adena Brook and Rush Run 2022 Fish Assemblage Results

IBI scores in Adena Brook in 2022 ranged from 22-36 with the site ADN01 (RM 0.23) the only site being in non-significant departure from the ecoregional biocriterion of 40. ADN02 (RM 0.52) had a fair IBI of 28 (30 in 2020), while ADN03 (RM 0.80) and ADN04 (RM 1.70) had poor and fair IBIs of 22 and 26 (22 and 24 in 2020), respectively (Table 43.) This pattern was tracked by the number of native species that was 10 at ADN01 (10 in 2020), 5 at ADN02 (6 in 2020), and 3 and 5 (3 and 3 in 2020) at the two upstream sites. DELT anomalies were zero at all four sites in 2020 and 2022. Two (2) sensitive species occurred at ADN01 (1 in 2020). The percentage of simple lithophils was fair at three of the four sites in 2022 compared to good at ADN02 and ADN04 and fair at ADN01 and ADN03. Tolerant species predominated by numbers at all sites in 2020 and 2022 resulting in a consistent very poor rating for this metric. Overall the Adena Run fish assemblage exhibited characteristics typical of small, urban headwater streams, but the attainment at ADN01 is unusual against the backdrop of nearly all urbanized sites in Ohio being impaired for WWH (Yoder et al. 2000). The attainment of the WWH IBI biocriterion was a significant improvement over the 1996 (20 and 22, poor) and 1999 (22 and 32, poor and fair) IBI scores of mostly poor quality at RMs 0.10 and 0.90 located close to ADN01 and ADN03.

Like Adena Brook, the single Rush Run IBI score was 36 which is a non-significant departure for the WWH IBI biocriterion of 40. It was 34 in 2020. The IBI in 2020 declined with distance upstream (MBI 2022). The site closest to the mouth at RSH01 (RM 0.24) had an IBI score (34) which just missed the nonsignificant departure from the ecoregional biocriterion for WWH (40).

Table 43. Fish assemblage response indicators in the Olentangy River tributaries in 1999, 2020, and 2022. The results for each indicator are color coded in accordance with the key at the bottom of the table.

Site ID	River Mile	Drainage Area (mi. ²)	Fish Assemblage Response Indicators											
			IBI		Native Species		%DELTA Anomalies		Sensitive Fish Species		%Simple Lithophils		%Tolerant Fish	
			1999/2020	2022	1999/2020	2022	1999/2020	2022	1999/2020	2022	1999/2020	2022	1999/2020	2022
Bartholomew Run (RM 14.48)														
BAR01	0.20	1.13	no fish data	32*	no fish data	6.0	no fish data	0.00	no fish data	0.0	no fish data	60.4	no fish data	95.42
Linworth Run (RM 9.99)														
LIN01	0.80	2.58	26*	26*	5.0	5.0	0.00	0.00	0.0	0.0	11.60	34.0	98.95	98.1
Rush Run (RM 8.75)														
RSH01	0.24	2.62	34*	36 ^{ns}	8.0	10.0	0.00	0.00	1.0	1.0	15.4	21.9	78.02	76.18
Tributary to Olentangy River (RM 8.45)														
TRIB01	0.00	1.08	no fish data	30*	no fish data	7.0	no fish data	0.00	no fish data	0.0	no fish data	27.1	no fish data	92.86
Tributary to Olentangy River (RM 7.82) (Bill Moose Run)														
BMR01	0.20	2.69	30*	40	9.0	10.0	0.00	0.00	0.0	2.0	39.6	24.7	78.02	85.83
Adena Brook (RM 6.00)														
ADN04	1.70	1.8	24*	26*	3.0	5.0	0.00	0.00	0.0	0.0	37.5	16.7	88.04	97.06
ADN03	0.80	2.28	22*	22*	3.0	3.0	0.00	0.00	0.0	0.0	7.4	11.0	90.15	91.91
ADN02	0.52	2.66	30*	28*	6.0	5.0	0.00	0.00	0.0	0.0	33.1	22.3	79.6	78.19
ADN01	0.23	2.71	40	36 ^{ns}	10.0	10.0	0.00	0.00	1.0	2.0	13.9	19.6	85.57	73.3
Turkey Run (RM 5.82)														
TUR01	0.70	2.09	20*	24*	3.0	3.0	0.00	0.00	0.0	0.0	43.3	17.7	100	100
Wahalla Hollow (RM 4.52)														
WAH01	1.00	1.13	12*	12*	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0	0
Glen Echo Ravine (RM 4.10)														
GER01	0.95	0.59	12*	12*	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0	0
Narrative Ranking Thresholds ^a	Excellent		44-60		>25		0.00		>15		>30		<15	
	Good		38-43		>14		<1.3		11-15		>20-30		>15-30	
	Fair		26-37		>10		<3.0		3-10		>10-20		>30-50	
	Poor		19-25		>7		>10		1-2		>5-10		>50-70	
	Very Poor		12-18		<7		>20		0		<5		>70	

Footnotes: ^a Narrative rating used in lieu of ICI (E - Exceptional; G - Good; F - Fair; P - Poor; VP - Very Poor). ^b As defined by Yoder and Rankin 1995) and Yoder and DeShon (2003).

It was also an incremental improvement over the IBI scores in 1994 (26, poor) and 1996 (28, fair) at the same location. IBI scores declined into the poor range at RSH02 (RM 1.03) and RSH03 (1.90) and into the very poor range with minimum IBI scores of 12 at RSH04 (RM 2.90) and RSH05 (RM 3.55), the latter having zero fish collected. The number of native species declined from 8 at RSH01 to 2 at RSH02 and 1 at RSH03 and RSH04. Only a single sensitive fish species was collected at RSH01 which is the only site with simple lithophils comprising 15.5% (fair). All four (4) sites that had fish were predominated by highly tolerant species with 78% at RSH01 and 100% at the other sites. None of the sites had any DELT anomalies. The fish assemblage responses are typical of moderate to severe impacts from urban causes and sources including hydrologic alteration, organic enrichment, and habitat modification that has exacerbated the effects of certain chemical pollutants including nutrients especially so in the upper reaches of Rush Run.

Other Olentangy River Tributaries 2022 Fish Assemblage Results

IBI scores in the other tributaries in 2022 ranged from 12-40 with both Wahalla Hollow and Glen Echo Ravine having no fish collected (Table 43). Both are small and prone to extreme flow fluctuations and are also functionally disconnected from the Olentangy River mainstem making natural recovery unlikely. The WWH IBI of 40 was attained in Bill Moose Run which was an improvement over the 1999 result of 30 (fair). While each were designated WWH as verified in 2003, the attainability of that use is in question. The other tributaries that had fish each had fair or poor IBI scores ranging from 24 (poor) to 32 (fair) with no more than 6 species, 0-1 sensitive species, and all with very high %tolerant species in the very poor range. The %simple lithophils varied from excellent in Bartholomew Run and Linworth Run to good at all except Turkey Run. Here again these fish assemblage responses are typical of small urban headwater streams. However, the tributaries with good and excellent habitat do retain the potential for improvement provided ingress from the mainstem is not impeded by impassable barriers. SSOs, urban runoff, and illicit discharges and releases are the most limiting variables in these tributaries.

2022 Macroinvertebrate Assemblage Results

A total of 77 macroinvertebrate taxa were collected in qualitative dip net, handpick samples from 12 sites in the nine (9) Olentangy River tributaries in 2022 (Appendix C). The most commonly collected taxa in terms of site occurrences were *Oligochaeta* (8), *Simulium sp* (8), *Polypedilum (P.) illinoense* (8), *Turbellaria* (7), *Baetis flavistriga* (7), *Cheumatopsyche sp* (7), *Diamesa sp* (7), *Tipula sp* (6), *Eukiefferiella claripennis* group (6), and *Argia sp* (5). Of these top ten most frequently occurring taxa two (2) are highly tolerant, one (1) is moderately tolerant, and the remaining seven (7) taxa are all facultative in their tolerance rankings.

To evaluate the overall quality of macroinvertebrate assemblages and gauge attainment of the biological criteria, narrative ratings of the qualitative sample are used in lieu of the ICI in very small streams (Table 44). Other macroinvertebrate metrics and attributes were also examined including the total number of taxa, the number of sensitive taxa, the number of qualitative EPT taxa, the number of toxic tolerant taxa, and the number of organic tolerant taxa were also

examined for each site to gauge the response types exhibited by the macroinvertebrate assemblage.

Adena Brook and Rush Run 2022 Macroinvertebrate Assemblage Results

The macroinvertebrate narrative ratings in Adena Brook were fair at three sites and poor at ADN04 upstream. The 2020 results were fair at all four sites, which fails to meet the WWH rating of good (Table 43). This was due to low numbers of sensitive (1 very poor and 3 poor) and qualitative EPT taxa (1 poor and 3 fair) in 2022. Compared to the other tributaries Adena Brook had the highest number of EPT taxa. The number of total taxa was similar at all four sites (fair) ranging from 29-38 (21-23 in 2020). Taxa tolerant of organic enrichment increased in 2022 with 6, 6, and 7 (all poor) at the upstream three sites and 4 (fair) at ADN01. There was one (1) toxic tolerant taxa collected at each site compared to zero in 2020.

The overall assessment of the macroinvertebrate assemblage quality at the single site in Rush Run was poor in 2022 compared to fair in 2020. It was likewise poor at the next three upstream sites in 2020. Site RSH05 had too little water at the time of the qualitative sampling to collect an adequate sample. Among the four remaining Rush Run sites that were sampled the number of total taxa ranged from nine (very poor) at RSH03 to 32 at RSH01 (fair) compared to 23 in 2022. The other two sites, RSH02 and RSH04 had 19 (poor) and 18 (poor) taxa, respectively. One sensitive taxa (very poor) 2 and 5 EPT taxa (fair) was collected at RSH01 in 2022. Both are reductions compared to 2020.

Other Olentangy River Tributaries 2022 Macroinvertebrate Assemblage Results

The macroinvertebrate narrative ratings in the other tributaries were fair at three sites and poor at four sites (Table 44). Total taxa ranged from 22-32 with all except Bartholomew Run having no more than 24 total taxa. Sensitive taxa were zero in Turkey Run, one at four locations, and two at one location. EPT taxa ranged from 2-7 with all except Linworth Run in the poor range. Each site had one toxic tolerant taxa with tolerant taxa ranging from 3 (fair) to 6 (poor) the latter in Bartholomew Run. The remaining sites had 3 or 4 tolerant taxa.

As with the fish assemblage, the macroinvertebrate responses are typical of moderate to severe impacts from urban causes and sources, including hydrologic alteration and habitat modification. As a result, the hardened surfaces of the watershed exacerbated the effects of certain chemical pollutants, including nutrients, particularly in the upper reaches of Rush Run and the tributaries in the lower portion of the study area. The degree of hydrological alteration (*i.e.*, stream desiccation) at site RSH05 in 2020 was so severe that a sample could not be collected. The biological responses are typical of small urban streams that are subjected to stormwater and periodic discharges (e.g., SSOs) that deliver organic pollution. Relative to other urban streams the retention of some mayflies and sensitive taxa in Adena Brook, Linworth Run, the Tributary at RM 8.45, and Bill Moose Run and the low number of toxic tolerant taxa is a positive in an otherwise impaired macroinvertebrate assemblage.

Table 44. Macroinvertebrate assemblage response indicators in the Olentangy River tributaries in 1999, 2020, and 2022. The results for each indicator are color coded in accordance with the key at the bottom of the table.

Site ID	River Mile	Drainage Area (mi. ²)	Macroinvertebrate Assemblage Response Indicators											
			ICI		Total Site Taxa		Sensitive Taxa		Qualitative EPT Taxa		# Toxic Tolerant		# Organic Tolerant	
			2020	2022	2020	2022	2020	2022	2020	2022	2020	2022	2020	2022
Bartholomew Run (RM 14.48)														
BAR01	0.2	1.13		P*		33		1		4		1		6
Linworth Run (RM 9.99)														
LIN01	0.9	2.58		F*		23		2		7		1		3
Rush Run (RM 8.75)														
RSH01	0.2	2.62	F*	P*	32	23	2	1	7	5	1	1	5	4
Tributary to Olentangy River (RM 8.45)														
TRIB01	0.1	1.08		F*		25		1		6		1		3
Tributary to Olentangy River (RM7.82) (Bill Moose Run)														
BMR01	0.2	2.69		F*		29		3		6		1		2
Adena Brook (RM 6.00)														
ADN04	1.6	1.8	F*	P*	22	29	2	1	6	3	0	1	2	6
ADN03	0.9	2.28	F*	F*	21	34	2	2	5	7	0	1	3	6
ADN02	0.7	2.66	F*	F*	22	38	2	3	7	6	0	1	3	7
ADN01	0.2	2.71	F*	F*	23	38	2	4	5	7	0	1	3	4
Turkey Run (RM 5.82)														
TUR01	0.7	2.09		P*		24		0		2		1		4
Wahalla Hollow (RM 4.58)														
WAH01	0.4	1.13		P*		24		1		3		1		4
Glen Echo Ravine (RM 4.10)														
GER01	1	0.59		P*		22		1		4		1		4
Narrative Ranking Thresholds	Excellent		≥42		>60		>16		>15		0		0	
	Good		32-40		>40-60		11-16		11-15		1		1 or 2	
	Fair		14-30		>20-40		6-10		6-10		≥2		≤5	
	Poor		8-12		>10-20		2-5		2-5		≥3		<8	
	Very Poor		0-6		<10		<2		<2		≥4		≥9	

^a - Narrative rating used in lieu of ICI (E - Exceptional; G - Good; F - Fair; P - Poor; VP - Very Poor; ^b - from Ohio EPA (2015a); ^c - as defined by Yoder and Rankin 1995) and Yoder and DeShon (2003).

Primary Headwater Habitat Assessment Results

Two tributaries, Linworth Run and Wahalla Hollow, were also assessed with the Primary Headwater Habitat methodology (Ohio EPA 2020b) that employed the collection of salamanders and the Headwater Habitat Evaluation Index (HHEI; Appendix D-3) in addition to the WWH suite of habitat and biological assessment methods (QHEI, fish, qualitative macroinvertebrates). Linworth Run had a HHEI score of 86 and Class 3A biological characteristics, but it already designated WWH so no assignment of a PHWH class was necessary. Wahalla Hollow had a very good HHEI score of 84, but lacked salamanders and had a poor macroinvertebrate narrative rating bot due to the current impacts from sewage overflows. It also lacked fish so no further action was taken to recommended and aquatic life use. It would possibly be PHWH Class 2 at best, but this will be deferred to a future assessment.

Synthesis of Results – Olentangy River Tributaries

Conditions for aquatic life and the attainment of aquatic life uses in the lower Olentangy River tributaries sampled in 2022 have been affected by the urbanization of each watershed. This includes the alteration of hydrology by the hardening of surfaces within the watershed, chemical pollution from stormwater in runoff and mixed with sewage from the sanitary sewer system, illicit spills and releases, and direct alterations to habitat.

Synthesis of the 2022 Results and Key Response Indicators

Table 45 represents a synthesis of the aquatic life use attainment status, the biological criteria by which aquatic life attainment status is derived, the indicators of biological quality and response to predominant stressors, indicators of habitat quality, and aspects of water column and sediment quality that are each normalized to their narrative scales of exceptional, good, fair, poor, and very poor quality and condition. Aquatic life use attainment status is the governing indicator of evaluating environmental stressors. Non-attainment of the WWH biocriteria was common for all the tributaries except the downstream most Adena Brook site (ADN01, RM 0.23) where “good” fish performance resulted in partial attainment in 2020 and 2022, Rush Run in 2022 which had a marginally good IBI result, and Bill Moose Run in 2022 which met the WWH IBI of 40. The fair macroinvertebrate performance at these sites resulted in Partial attainment. The remaining tributary sites had substantially lower IBI scores, but most with good to exceptional habitat. The fish assemblage especially was predominated by tolerant species and an absence or low numbers of sensitive species, excepting the sites at ADN01, Rush Run, and Bill Moose Run. The macroinvertebrates were evenly split between poor and fair narrative assessments. The numbers of qualitative EPT taxa and sensitive taxa were fair or poor. All other biological response signatures were good or fair. There were few exceedances of poor or very poor chemical thresholds and most were in the fair range. In 2020 and 2022, the occurrence of elevated levels of conductivity, TDS, chlorides, and zinc at ADN02 and elevated conductivity, chlorides, and TDS at ADN04 in 2022 suggests intermittent releases and spills which Ohio EPA (2001, 2005) and FLOW (2003) characterized as being recurrent in the 1990s and 2000s. The biological results, the visual evidence of a spill in July 2020, and comments to the field crews by local residents suggest this has continued to the present. Some of the releases are expected to be addressed by Blueprint Columbus, but sources independent of that

Table 45. The status of aquatic life use attainment, biological criteria, habitat, biological response signatures, and column chemical exceedances in the Olentangy River tributaries sampled in 2022.

Site ID	River Mile Fish/Macroinvertebrates	Aquatic Life Use Status ^c	IBI ^b	ICI ^b	QHEI	Good QHEI Attributes	Poor QHEI Attributes	%DELT	Sensitive Fish Species	Qual EPT Taxa	No. Toxic Tolerant Taxa	No. Organic Tolerant Taxa	Water Column Poor/VP Exceedances	Sediment Chemical PEC/PEL Exceedances	Sediment PAH TEL/LEL Exceedances
Bartholomew Run (RM 14.48)															
BAR01	0.20/0.20	NON	32*	P*	63.5	7	3	0.00	0.0	4	1	6	1	1	1
Linworth Run (RM 9.99)															
LIN01	0.80/0.90	NON	26*	F*	63.0	4	4	0.00	0.0	7	1	3	1	5	8
Rush Run (RM 8.75)															
RSH01	0.24/0.20	NON	36 ^{ns}	P*	72.0	8	3	0.00	1.0	5	1	4	2	5	8
Tributary to Olentangy River (RM 8.45)															
TRIB01	0.20/0.10	NON	30*	F*	65.5	7	2	0.00	0.0	6	1	3	1	0	0
Tributary to Olentangy River (RM7.82) (Bill Moose Run)															
BMR01	0.20/0.20	PARTIAL	40	F*	70.5	5	4	0.00	2.0	6	1	2	0	3	6
Adena Brook (RM 6.00)															
ADN04	1.70/1.60	NON	26*	P*	76.0	8	3	0.00	0.0	3	1	6	3		
ADN03	0.80/0.90	NON	22*	F*	60.5	5	5	0.00	0.0	7	1	6	2		
ADN02	0.52/0.70	NON	28*	F*	57.3	4	5	0.00	0.0	6	1	7	3		
ADN01	0.23/0.20	NON	36 ^{ns}	F*	75.5	8	3	0.00	2.0	7	1	4	1	6	11
Turkey Run (RM 5.82)															
TUR01	0.70/0.70	NON	24*	P*	69.5	5	4	0.00	0.0	2	1	4	0	5	7
Wahalla Hollow (RM 4.58)															
WAH01	1.00/0.40	Undesig.	12*	P*	47.0	3	4	0.00	0.0	3	1	4	0	7	12
Glen Echo Ravine (RM 4.10)															
GER01	0.95/1.00	NON	12*	P*	57.0	6	4	0.00	0.0	4	1	4	2	6	11
Narrative Threshold Rankings	Exceptional	FULL	44-60	≥42	≥70	≥8	≤1	0.00	>15	>16	0	0	0	0	0
	Good	FULL	38-43	32-40	≥55	≥6	≤4	<0.10	11-15	11-16	1	1 or 2	1	0	<4
	Fair	PART./NON	26-37	14-30	>43	>3	<5	<1.30	3-10	6-10	>2	<5	2	1	<7
	Poor	NON-Poor	19-25	8-12	>30	>2	≥6	>5.0	1-2	2-5	>3	<8	3	3	<10
	Very Poor	NON-V.Poor	12-18	0-6	<30	<1	>7	>10	0.0	<2	>4	>9	4	5	>10

effort will likely remain until action to limit them are taken. High PAH levels in sediment exceeding the PEC/SEL thresholds occurred in all except the upstream most tributary, Bartholomew Run and the Unnamed Tributary at RM 8.45. Each flow from the less densely urbanized western side of the Olentangy River mainstem, but both had fair/poor and fair fish and macroinvertebrate results. The general urban footprint extends from Linworth Run downstream with the severity of the responses and exceedances being more frequent in the tributaries to the lower mainstem where older urbanization is more prevalent along with increased SSOs and marginal habitat in some cases. This was reflected in Wahalla Hollow and Glen Echo Ravine results especially although the number of exceedances of PAH compounds was no more than that observed at the ADN01 in Adena Brook. Urban stormwater from paved surfaces is the likely source of these exceedances.

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APPENDIX A: 2022 Site Characteristics and Location Data

Appendix Table A-1. Site location characteristics, indicators, and parameters at Scioto River and Olentangy River mainstem sites and Olentangy River tributary sites sampled in 2020.

Site ID	Basin	Stream	River_Stream	RM - WQ	RM-Fish	RM-Macro	Drainage Area (mi. ²)	General Location	Water Chemistry		Fish		Macroinvertebrates	Macroinvertebrate		Habitat	Data-sonde	Datasoned		Field Chem	Demand	Nutrient	Metals	Bacteria	Sediment Chemistry	
									Latitude	Longitude	Fish	Latitude		Longitude	Latitude			Longitude	Latitude							Longitude
Scioto River Mainstem																										
SR01	02	001	Scioto River	136.50	136.00	136.60	1050	Dst. 5th Ave. adj. to old gravel pits	39.9894*	-83.0678*	A	39.9825*	-83.0654*	HD	39.9912*	-83.0689*	QHEI	X	39.98863	-83.06749	8X	6X	6X	6X	6X	X
SR02	02	001	Scioto River	133.40	133.25	133.40	1070	Dst. Dublin WTP Dam	39.9670*	-83.0340*	A	39.9654*	-83.0321*	HD	39.9666*	-83.0339*	QHEI	X	39.967075	-83.034198	8X	6X	6X	6X	6X	X
SR03	02	001	Scioto River	132.70	132.80	132.60	1070	Dst. I-670 bridge (formerly impounded)	39.9649*	-83.0225*	A	39.9659*	-83.0241*	HD	39.9633*	-83.0211*	QHEI	X	39.96555	-83.02321	8X	6X	6X	6X	6X	X
SR04	02	001	Scioto River	132.10	131.95	132.10	1610	Dst. Olentangy River @RR bridge	39.9647*	-83.0127*	A	39.9646*	-83.0099*	HD	39.9641*	-83.0131*	QHEI	X	39.96463	-83.01461	8X	6X	6X	6X	6X	X
SR05	02	001	Scioto River	129.90	130.45	130.10	1620	Ust. Greenlawn Ave. dam	39.9415*	-83.0057*	A	39.9475*	-83.0138*	HD	39.9423*	-83.0102*	QHEI	X	39.94144	-83.00555	8X	6X	6X	6X	6X	X
SR06	02	001	Scioto River	129.50	129.23	129.00	1620	Dst. Greenlawn Ave. dam	39.9396*	-83.0001*	A	39.9363*	-83.0004*	HD	39.9329*	-83.0042*	QHEI	X	39.93689	-82.99974	8X	6X	6X	6X	6X	X
SR07	02	001	Scioto River	127.70	127.60	127.70	1620	Dst. Frank Rd. (St. Rt. 104)	39.9166*	-83.0102*	A	39.9144*	-83.0101*	HD	39.9165*	-83.0094*	QHEI	X	39.91623	-83.01015	8X	6X	6X	6X	6X	X
SR08.2	02	001	Scioto River	127.40	127.25	127.40	1620	Dst. OARS Outfall; ust. JP 001	39.9118*	-83.0105*	A	39.9096*	-83.0096*	HD	39.9118*	-83.0104*	QHEI				8X	6X	6X	6X	6X	X
SRJPMZ	02	001	Scioto River	127.00	127.00	127.00	1620	Jackson Pike 001 Mixing Zone (HD and 100 meter fish site)	39.9065*	-83.0088*	A	39.9060*	-83.0086*	HD	39.9060*	-83.0087*	QHEI				8X	6X	6X	6X	6X	X
SR08	02	001	Scioto River	126.20	126.40	126.50	1630	Dst. Jackson Pike WWTP	39.8984*	-83.0004*	A	39.9014*	-83.0006*	HD	39.9016*	-83.0033*	QHEI	X	39.89873	-83.0039	8X	6X	6X	6X	6X	X
SR09	02	001	Scioto River	125.30	125.05	125.40	1640	Dst. Shelly Materials bridge	39.8914*	-83.0100*	A	39.8888*	-83.0152*	HD	39.8916*	-83.0097*	QHEI	X	39.89145	-83.010981	8X	6X	6X	6X	6X	X
SR10	02	001	Scioto River	123.80	124.20	124.50	1670	Dst. I-270 bridge adjacent quarry on RL	39.8734*	-83.0243*	A	39.8776*	-83.0192*	HD	39.8829*	-83.0180*	QHEI	X	39.873471	-83.024275	8X	6X	6X	6X	6X	X
SR11	02	001	Scioto River	120.10	119.90	120.10	1700	Ust. 665 bridge	39.8337*	-83.0091*	A	39.8315*	-83.0098*	HD	39.8338*	-83.0092*	QHEI	X	39.833691	-83.008775	8X	6X	6X	6X	6X	X
SRCSMZ	02	001	Scioto River	118.20	118.20	118.20	1700	Southerly 001 Mixing Zone (HD and 100 meter fish site)	39.8120*	-83.0164*	A	39.8109*	-83.0163*	HD	39.8110*	-83.0160*	QHEI				8X	6X	6X	6X	6X	X
SR12	02	001	Scioto River	118.00	117.80	118.00	1700	Dst. Southerly WWTP	39.8090*	-83.0161*	A	39.8070*	-83.0151*	HD	39.8092*	-83.0158*	QHEI	X	39.8064	-83.01466	8X	6X	6X	6X	6X	X
SR13	02	001	Scioto River	116.90	117.00	116.80	2260	Dst. Big Walnut Creek	39.7965*	-83.0122*	A	39.7972*	-83.0118*	HD	39.7945*	-83.0116*	QHEI	X	39.794992	-83.011264	8X	6X	6X	6X	6X	X
SR14	02	001	Scioto River	116.00	115.75	116.00	2260	Dst. Former Pickaway Power Plant site	39.7832*	-83.0101*	A	39.7805*	-83.0093*	HD	39.7841*	-83.0100*	QHEI	X	39.78299	-83.00974	8X	6X	6X	6X	6X	X
SR15	02	001	Scioto River	114.40	113.85	114.00	2270	Dst. St. Rt. 762	39.7641*	-82.9975*	A	39.7641*	-83.0022*	HD	39.7599*	-82.9986*	QHEI	X	39.764894	-82.998169	8X	6X	6X	6X	6X	X
SR16	02	001	Scioto River	109.30	109.23	109.20	2311	Dst. St. Rt. 316	39.7187*	-83.0118*	A	39.7173*	-83.0119*	HD	39.7181*	-83.0118*	QHEI	X	39.717957	-83.011864	8X	6X	6X	6X	6X	X
SR17	02	001	Scioto River	108.50	107.35	107.40	2320	Dst. Walnut Creek	39.7081*	-83.0130*	A	39.6946*	-83.0012*	HD	39.6959*	-83.0020*	QHEI	X	39.698365	-83.004491	8X	6X	6X	6X	6X	X
SR18	02	001	Scioto River	105.10	105.10	106.00	2620	Dst. Walnut Creek	39.6706*	-82.9884*	A	39.6698*	-82.9879*	HD	39.6804*	-82.9865*	QHEI	X	39.66574	-82.98892	8X	6X	6X	6X	6X	X
SR19	02	001	Scioto River	102.10	101.83	102.00	2640	Dst. Commercial Point Rd. bridge	39.6327*	-82.9624*	A	39.6287*	-82.9612*	HD	39.6306*	-82.9617*	QHEI	X	39.63213	-82.96149	8X	6X	6X	6X	6X	X
SR20	02	001	Scioto River	99.90	100.05	100.10	3200	Circleville riffle (Ust. U.S. Rt. 22)	39.6027*	-82.9556*	A	39.6025*	-82.9559*	HD	39.6041*	-82.9552*	QHEI	X	39.605867	-82.956776	8X	6X	6X	6X	6X	X
SR21	02	001	Scioto River	99.40	99.35	99.40	3220	Dst. Former CCA discharge; ust. Circleville WWTP	39.5974*	-82.9567*	A	39.5977*	-82.9587*	HD	39.5976*	-82.9580*	QHEI	X	39.59773	-82.95951	8X	6X	6X	6X	6X	X
SR22	02	001	Scioto River	98.70	98.50	98.70	3220	Dst. Circleville WWTP	39.5987*	-82.9707*	A	39.5987*	-82.9719*	HD	39.5989*	-82.9702*	QHEI				8X	6X	6X	6X	6X	X
SR23	02	001	Scioto River	97.90	97.90	97.90	3220	Ust. old RR bridge Dst. Wickett Dam at Canal Park	39.5888*	-82.9709*	A	39.5879*	-82.9704*	HD	39.5895*	-82.9720*	QHEI	X	39.58817	-82.97086	8X	6X	6X	6X	6X	X
Big Walnut Creek																										
BW06	02	100	Big Walnut Creek	9.60	9.65	9.60	540	Lockbourne Rd. at Hamilton Twp. Park	39.8496*	-82.9720*	P	39.8499*	-82.9710*	HD	39.8491*	-82.9740*	QHEI	X	39.849406	-82.972697	8X	6X	6X	6X	6X	X
Olentangy River Mainstem																										
OLN05	02	400	Olentangy River	14.90	14.90	14.40	483	Dst. Powell Road (Highbanks Metropark)	40.1545*	-83.0449*	P	40.1533*	-83.0448*	HD	40.1485*	-83.0412*	QHEI	X	40.155155	-83.04532	8X	6X	6X	3X	6X	X
OLN07	02	400	Olentangy River	13.10	12.90	13.30	490	Olentangy R. Dst. Olentangy ECC	40.1338*	-83.0330*	P	40.1315*	-83.0337*	HD	40.1368*	-83.0314*	QHEI	X	40.133459	-83.033063	8X	6X	6X	3X	6X	X
OLN08	02	400	Olentangy River	11.95	12.30	11.90	502	Olentangy R. @Worthington Ust. I-270 N.	40.1175*	-83.0314*	P	40.1229*	-83.0332*	HD	40.1176*	-83.0314*	QHEI				8X	6X	6X	3X	6X	X
OLN09	02	400	Olentangy River	8.50	8.40	8.50	518	Broad Meadows Park - dst. Bike Path Bridge (dst. Rush Run)	40.0742*	-83.0350*	P	40.0719*	-83.0344*	HD	40.0732*	-83.0347*	QHEI	X	40.074109	-83.035092	8X	6X	6X	3X	6X	X
OLN10	02	400	Olentangy River	6.80	7.10	7.00	520	Ust. Henderson Rd. - dst. Beechwood Run	40.0518*	-83.0310*	P	40.0537*	-83.0301*	HD	40.0559*	-83.0285*	QHEI	X	40.05156	-83.03139	8X	6X	6X	3X	6X	X
OLN11	02	400	Olentangy River	5.50	5.65	5.50	527	Ust. W. North Broadway - dst. Adena Brook	40.0340*	-83.0267*	P	40.0361*	-83.0271*	HD	40.0334*	-83.0264*	QHEI				8X	6X	6X	3X	6X	X
OLN12	02	400	Olentangy River	4.50	4.30	4.50	531	Ust. Dodridge Dam in impoundment adj. OSU Wetland Res.	40.0220*	-83.0199*	P	40.0210*	-83.0166*	HD	40.0221*	-83.0205*	QHEI	X	40.022049	-83.020259	8X	6X	6X	3X	6X	X
OLN01	02	400	Olentangy River	3.90	3.95	3.90	535	Dst. Dodridge lowhead dam (Ust. Dodridge St)	40.0162*	-83.0164*	P	40.0143*	-83.0164*	HD	40.0167*	-83.0163*	QHEI	X	40.016632	-83.016176	8X	6X	6X	3X	6X	X
OLN02	02	400	Olentangy River	2.00	2.00	2.00	540	Ust. Former 5th Ave. Dam (formerly impounded) - King Ave.	39.9907*	-83.0241*	P	39.9901*	-83.0242*	HD	39.9906*	-83.0239*	QHEI	X	39.989335	-83.023966	8X	6X	6X	3X	6X	X
OLN03	02	400	Olentangy River	1.50	1.80	1.70	540	Dst. Former 5th Ave. Dam at 3rd Ave.	39.9842*	-83.0212*	P	39.9863*	-83.0221*	HD	39.9865*	-83.0229*	QHEI				8X	6X	6X	3X	6X	X
OLN04	02	400	Olentangy River	0.25	0.20	0.20	543	Dst. I-670 bridge, ust. confluence	39.9669*	-83.0201*	P	39.9674*	-83.0201*	HD	39.9664*	-83.0190*	QHEI	X	39.96676	-83.019658	8X	6X	6X	3X	6X	X
Bartholemew Run (RM 14.48)																										
BAR01	02	403	Bartholemew Run (14.48)	0.70	0.70	0.70	0.70	Bennet Rd.	40.1553*	-83.0631*	E	40.1553*	-83.0631*	QL	40.1553*	-83.0631*	QHEI				5X	4X	4X	4X	4X	X
Linworth Run (RM 9.99)																										
LIN01	02	442	Linworth Run (9.90)	0.90	0.90	0.90	0.90	Linworth Rd.	40.0929*	-83.0497*	E	40.0929*	-83.0497*	QL	40.0929*	-83.0497*	QHEI				5X	4X	4X	4X	4X	X
Rush Run (RM 8.75)																										
RSH01	02	403	Rush Run (8.75)	0.25	0.24	0.20	2.62	Ust. mouth in Rush Run Park	40.0763*	-83.0278*	E	40.0763*	-83.0269*	QL	40.0764*	-83.0275*	QHEI				5X	4X	4X	4X	4X	X
Unnamed Tributary to Olentangy R. (RM 8.45)																										
TRIB01	02	492	Trib. to Olentangy R. (RM 8.45)	0.1																						

Appendix Table A-1. Legend.

Indicator Groups & Parameters									
Fish	Macroinvertebrates	Habitat	Datasonde	Field	Demand	Nutrients	Metals	Bacteria	Sed. Metals
A - Boat	HD - Artificial substrates	QHEI ¹	Short-term (4-5 days)	Temp.	BOD ₅	NH ₃ -N	Cd	<i>E. coli</i>	Cd
P - Raft	QL - Qualitative sample		Long-term (June-Sept.)	Conduct.	Chloride	NO ₃ -N	Cu		Cu
D - Roller Barge				D.O.	Sulfate	NO ₂ -N	Pb		Pb
E - Longline				pH	TDS	TKN	Ni		Zn
F - Backpack					TSS	Total P	Zn		Ni
					Cond.	Ortho P	Fe		Fe
					pH	Ses. Chla	Ca		As
						Ben. Chla	Mg		Ag
							As		Cr
							Ag		Sed. Organics
							Cr		BNAs
									VOCs
									PAHs
									Pesticides
									PCBs

¹ QHEI - Qual. Habitat Eval. Index

APPENDIX B: SCIOTO RIVER FISH ASSEMBLAGE DATA 2022

- B-1: Scioto River IBI Metrics, IBI Scores, and MIwb Scores 2022**
 - B-2: Scioto River Fish Species Grand Ust. Greenlawn Dam 2022**
 - B-3: Scioto River Fish Species Grand Dst. Greenlawn Dam 2022**
 - B-4: Scioto River Fish Species by Site and Sample 2022**
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Appendix Table B-1. Boatable Ohio IBI scores and metrics for data collected in Scioto River mainstem and Big Walnut Creek in 2022.

Site ID	River Mile	Type	Drainage Date	Drainage area (sq mi)	Number of				Percent of Individuals						Rel.No. tolerants /(1.0 km)	Modified			
					Total species	Sunfish species	Sucker species	Intolerant species	Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omnivores	Top carnivores	Insectivores		DELTA anomalies	IBI	lwb	Source
Scioto River - (02001)																			
Year: 2022																			
SR01	136.05	A	08/17/2022	1050	20(3)	5(5)	5(3)	4(5)	31(3)	35(3)	13(5)	4(5)	21(5)	68(5)	3.1(1)	338(3)	46	9.6	MBI
SR02	133.40	A	08/11/2022	1067	22(5)	5(5)	7(5)	4(5)	15(1)	21(1)	13(5)	17(3)	18(5)	52(3)	1.0(5)	182(1)	44	9.6	MBI
SR03	133.00	A	08/11/2022	1068	23(5)	1(1)	8(5)	6(5)	38(5)	44(5)	4(5)	4(5)	20(5)	62(5)	0.8(3)	246(3)	52	9.6	MBI
SR04	132.10	A	08/11/2022	1610	15(3)	5(5)	4(3)	0(1)	26(3)	26(3)	8(5)	6(5)	15(5)	72(5)	2.0(3)	180(1) *	42	8.7	MBI
SR05	130.40	A	08/11/2022	1615	15(3)	4(5)	5(3)	0(1)	16(1)	16(1)	19(3)	24(3)	10(5)	61(5)	0.0(5)	174(1)	36	8.4	MBI
SR06	129.40	A	08/18/2022	1620	35(5)	3(3)	9(5)	8(5)	10(1)	26(3)	3(5)	18(3)	7(3)	74(5)	0.0(5)	370(3)	46	10.1	MBI
SR06	129.40	A	09/16/2022	1620	27(5)	3(3)	4(3)	7(5)	6(1)	35(3)	3(5)	13(5)	17(5)	65(5)	0.0(5)	200(3)	48	9.6	MBI
SR07	127.70	A	08/18/2022	1628	39(5)	4(5)	8(5)	7(5)	9(1)	24(3)	6(5)	13(5)	7(3)	75(5)	0.7(3)	500(5)	50	10.6	MBI
SR07	127.70	A	09/16/2022	1628	35(5)	4(5)	6(5)	8(5)	6(1)	22(3)	6(5)	17(3)	5(3)	74(5)	0.7(3)	520(5)	48	10.6	MBI
SR08.2	127.40	A	08/18/2022	1620	23(5)	3(3)	5(3)	2(3)	2(1)	15(1)	17(3)	44(1)	5(3)	43(3)	1.3(3)	250(3)	32	9.4	MBI
SR08.2	127.40	A	09/16/2022	1620	25(5)	4(5)	6(5)	2(3)	1(1)	11(1)	6(5)	37(1)	9(3)	50(3)	0.7(5)	258(3)	40	9.3	MBI
SRJPMZ	127.00	A	08/18/2022	1628	7(1)	1(1)	4(3)	1(1)	0(1)	5(1)	0(5)	59(1)	0(1)	41(3)	0.0(5)	370(3)	26	8.4	MBI
SRJPMZ	127.00	A	09/16/2022	1628	5(1)	0(1)	3(3)	1(1)	6(1)	35(3)	0(5)	47(1)	0(1)	53(3)	0.0(5)	170(1) *	26	7.3	MBI
SR08	126.55	A	08/31/2022	1630	27(5)	3(3)	6(5)	2(3)	15(1)	18(1)	15(5)	22(3)	10(3)	65(5)	0.9(3)	196(1)	38	10.0	MBI
SR08	126.55	A	10/15/2022	1630	30(5)	4(5)	6(5)	6(5)	9(1)	24(3)	5(5)	13(5)	11(5)	73(5)	0.0(5)	186(1) *	50	9.6	MBI
SR09	125.20	A	08/31/2022	1640	16(3)	3(3)	4(3)	0(1)	4(1)	9(1)	12(5)	42(1)	13(5)	34(3)	0.0(5)	134(1) *	32	8.5	MBI
SR09	125.20	A	10/15/2022	1640	21(5)	3(3)	8(5)	2(3)	8(1)	15(1)	5(5)	22(3)	23(5)	52(3)	0.0(5)	172(1) *	40	9.3	MBI
SR10	124.40	A	08/31/2022	1667	30(5)	3(3)	7(5)	4(5)	7(1)	24(3)	4(5)	7(5)	11(5)	76(5)	0.0(5)	314(3)	50	10.4	MBI
SR10	124.40	A	10/15/2022	1667	31(5)	3(3)	6(5)	5(5)	8(1)	39(5)	3(5)	6(5)	7(3)	84(5)	0.0(5)	276(3)	50	9.7	MBI
SR11	120.10	A	08/08/2022	1700	31(5)	3(3)	7(5)	3(3)	14(1)	24(3)	7(5)	13(5)	18(5)	43(3)	1.5(3)	400(3)	44	10.5	MBI
SR11	120.10	A	09/13/2022	1700	36(5)	4(5)	8(5)	6(5)	20(3)	27(3)	6(5)	11(5)	9(3)	66(5)	0.0(5)	374(3)	52	10.5	MBI
SRCSMZ	118.10	A	08/08/2022	1708	10(3)	3(3)	4(3)	0(1)	3(1)	3(1)	14(5)	46(1)	9(3)	43(3)	0.0(5)	60(1) *	30	7.6	MBI
SRCSMZ	118.10	A	09/13/2022	1708	14(3)	2(3)	4(3)	0(1)	3(1)	8(1)	25(3)	53(1)	10(3)	30(3)	5.0(3)	60(1) *	26	7.6	MBI
SR12	118.00	A	08/08/2022	1708	25(5)	3(3)	6(5)	4(5)	26(3)	44(5)	3(5)	16(5)	7(3)	72(5)	3.1(1)	250(3)	48	10.2	MBI

◆ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

Appendix Table B-1. Boatable Ohio IBI scores and metrics for data collected in Scioto River mainstem and Big Walnut Creek in 2022.

Site ID	River Mile	Type	Drainage Date	Drainage area (sq mi)	Number of				Percent of Individuals							Rel.No. tolerants /(1.0 km)	Modified IBI	lwb	Source
					Total species	Sunfish species	Sucker species	Intolerant species	Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omnivores	Top carnivores	Insectivores	DELTA anomalies				
SR12	118.00	A	09/13/2022	1708	27(5)	2(3)	8(5)	5(5)	20(3)	35(3)	1(5)	19(3)	8(3)	68(5)	1.9(3)	306(3)	46	10.2	MBI
SR13	117.15	A	08/08/2022	2260	34(5)	2(3)	7(5)	6(5)	25(3)	44(5)	4(5)	9(5)	11(5)	74(5)	0.7(5)	264(3)	54	10.3	MBI
SR13	117.15	A	09/13/2022	2260	28(5)	3(3)	7(5)	4(5)	15(1)	31(3)	2(5)	11(5)	7(3)	70(5)	2.4(3)	242(3)	46	10.7	MBI
SR14	116.00	A	08/08/2022	2260	32(5)	2(3)	9(5)	8(5)	25(3)	48(5)	1(5)	5(5)	4(1)	76(5)	0.0(5)	378(3)	50	10.8	MBI
SR14	116.00	A	09/13/2022	2260	33(5)	1(1)	8(5)	9(5)	14(1)	41(5)	1(5)	5(5)	3(1)	81(5)	0.3(5)	636(5)	48	10.5	MBI
SR15	114.00	A	08/10/2022	2275	35(5)	3(3)	7(5)	8(5)	25(3)	49(5)	7(5)	9(5)	2(1)	75(5)	1.8(3)	314(3)	48	10.3	MBI
SR15	114.00	A	09/14/2022	2275	37(5)	3(3)	5(3)	10(5)	14(1)	64(5)	1(5)	2(5)	5(1)	88(5)	0.0(5)	666(5)	48	10.4	MBI
SR16	109.35	A	08/10/2022	2310	37(5)	3(3)	9(5)	8(5)	15(1)	45(5)	1(5)	3(5)	8(3)	84(5)	0.5(5)	430(5)	52	10.9	MBI
SR16	109.35	A	09/14/2022	2310	32(5)	1(1)	8(5)	7(5)	13(1)	61(5)	1(5)	1(5)	5(1)	89(5)	0.2(5)	804(5)	48	10.1	MBI
SR17	107.50	A	08/10/2022	2320	29(5)	2(3)	7(5)	4(5)	21(3)	44(5)	3(5)	7(5)	7(3)	75(5)	0.8(3)	258(3)	50	10.2	MBI
SR17	107.50	A	09/14/2022	2320	27(5)	0(1)	7(5)	11(5)	20(3)	47(5)	2(5)	8(5)	4(1)	82(5)	1.5(3)	388(3)	46	10.3	MBI
SR18	105.25	A	08/10/2022	2610	23(5)	0(1)	8(5)	5(5)	27(3)	49(5)	0(5)	4(5)	9(3)	75(5)	2.6(3)	154(1) *	46	9.5	MBI
SR18	105.25	A	09/14/2022	2610	31(5)	2(3)	7(5)	8(5)	9(1)	48(5)	1(5)	2(5)	2(1)	92(5)	0.0(5)	678(5)	50	9.7	MBI
SR19	102.00	A	08/10/2022	2638	30(5)	2(3)	7(5)	8(5)	27(3)	77(5)	1(5)	2(5)	2(1)	91(5)	0.8(3)	254(3)	48	9.7	MBI
SR19	102.00	A	09/14/2022	2638	28(5)	0(1)	9(5)	6(5)	26(3)	61(5)	1(5)	5(5)	5(3)	89(5)	0.0(5)	276(3)	50	9.9	MBI
SR20	100.24	A	10/14/2022	3200	31(5)	4(5)	7(5)	6(5)	10(1)	15(1)	1(5)	3(5)	12(5)	81(5)	0.0(5)	283(3)	50	9.1	MBI
SR20	100.24	A	09/01/2022	3200	30(5)	3(3)	6(5)	5(5)	13(1)	25(3)	4(5)	10(5)	11(5)	73(5)	0.0(5)	294(3)	50	9.8	MBI
SR21	99.52	A	09/01/2022	3220	32(5)	3(3)	8(5)	7(5)	12(1)	42(5)	3(5)	3(5)	3(1)	88(5)	0.0(5)	304(3)	48	9.4	MBI
SR21	99.52	A	10/14/2022	3220	34(5)	3(3)	7(5)	10(5)	6(1)	28(3)	5(5)	4(5)	7(3)	86(5)	0.0(5)	350(3)	48	9.5	MBI
SR22	98.65	A	09/01/2022	3220	21(5)	3(3)	5(3)	4(5)	19(3)	27(3)	6(5)	6(5)	13(5)	69(5)	0.0(5)	144(1) *	48	9.4	MBI
SR22	98.65	A	10/14/2022	3220	24(5)	2(3)	5(3)	3(3)	17(1)	27(3)	13(5)	16(5)	23(5)	54(5)	0.0(5)	144(1) *	44	9.1	MBI
Big Walnut Creek - (02100)																			
Year: 2022																			
BW06	9.80	A	08/09/2022	547	38(5)	5(5)	8(5)	11(5)	21(3)	62(5)	6(5)	7(5)	4(1)	86(5)	0.0(5)	598(5)	54	10.6	MBI
BW06	9.80	A	10/07/2022	547	35(5)	3(3)	9(5)	10(5)	18(1)	48(3)	9(5)	35(1)	1(1)	62(5)	0.0(5)	750(5)	44	10.9	MBI

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

Appendix B-2. Grand totals for fish species sampled by MBI upstream of Greenlawn Dam and in the lower Olentangy River in 2022.

Family Code	Species Code	Common Name	Latin Name	Ohio Tolerance	Number/ Km	% by Number	Kg/Km	% by Biomass	No. of Samples
40	010	Golden Redhorse	<i>Moxostoma erythrurum</i>	M	392	13.00	253.25	15.70	9
77	009	Bluegill Sunfish	<i>Lepomis macrochirus</i>	P	213	6.72	6.59	0.41	8
77	008	Green Sunfish	<i>Lepomis cyanellus</i>	T	179	5.72	1.60	0.10	9
20	003	Gizzard Shad	<i>Dorosoma cepedianum</i>		177	5.59	16.99	1.05	9
40	015	Northern Hog Sucker	<i>Hypentelium nigricans</i>	M	163	5.53	29.07	1.80	6
43	044	Central Stoneroller	<i>Camptostoma anomalum</i>		133	5.46	1.27	0.08	7
43	015	Suckermouth Minnow	<i>Phenacobius mirabilis</i>		94	5.21	1.22	0.08	4
77	004	Smallmouth Bass	<i>Micropterus dolomieu</i>	M	159	5.03	49.61	3.08	8
47	002	Channel Catfish	<i>Ictalurus punctatus</i>		129	4.08	143.96	8.92	9
43	032	Spotfin Shiner	<i>Cyprinella spiloptera</i>		117	3.89	0.82	0.05	8
40	013	River Redhorse	<i>Moxostoma carinatum</i>	I	109	3.45	308.44	19.12	7
43	001	Common Carp	<i>Cyprinus carpio</i>	T	104	3.39	296.09	18.35	9
77	011	Longear Sunfish	<i>Lepomis megalotis</i>	M	94	2.95	1.50	0.09	6
43	021	Silver Shiner	<i>Notropis photogenis</i>	I	90	2.83	102.76	6.37	6
77	006	Largemouth Bass	<i>Micropterus nigricans</i>		83	2.70	1.71	0.11	8
43	034	Sand Shiner	<i>Miniellus stramineus</i>	M	60	2.32	0.24	0.01	5
80	011	Logperch	<i>Percina caprodes</i>	M	59	2.01	1.09	0.07	6
80	016	Banded Darter	<i>Etheostoma zonale</i>	I	39	1.88	0.10	0.01	5
40	004	Smallmouth Buffalo	<i>Ictiobus bubalus</i>		60	1.88	120.26	7.45	6
40	009	Black Redhorse	<i>Moxostoma duquesnei</i>	I	51	1.82	52.36	3.25	7
40	005	Quillback Carpsucker	<i>Carpodes cyprinus</i>		55	1.76	36.57	2.27	7
43	043	Bluntnose Minnow	<i>Pimephales notatus</i>	T	52	1.70	0.16	0.01	7
40	008	Silver Redhorse	<i>Moxostoma anisurum</i>	M	41	1.38	41.30	2.56	6
80	026	Sauger X Walleye	HYBRID		42	1.32	0.90	0.06	6
77	010	Orangespotted Sunfish	<i>Lepomis humilis</i>		28	0.88	0.22	0.01	4
43	022	Rosyface Shiner	<i>Notropis rubellus</i>	I	18	0.63	0.06	0.00	5
80	019	Bluebreast Darter	<i>Nothonotus camurus</i>	R	15	0.57	0.08	0.00	5
43	041	Bullhead Minnow	<i>Pimephales vigilax</i>		18	0.57	0.06	0.00	1
80	024	Fantail Darter	<i>Etheostoma flabellare</i>		13	0.57	0.03	0.00	4

Appendix Table B-2. continued.

Family Code	Species Code	Common Name	Latin Name	Ohio Tolerance	Number/Km	% by Number	Kg/Km	% by Biomass	No. of Samples
80	022	Rainbow Darter	<i>Etheostoma caeruleum</i>	M	10	0.57	0.05	0.00	2
77	015	Green X Bluegill Sunfish	<i>HYBRID</i>		15	0.50	0.63	0.04	5
77	002	Black Crappie	<i>Pomoxis nigromaculatus</i>		12	0.38	1.69	0.10	4
40	006	River Carpsucker	<i>Carpoides carpio carpio</i>		12	0.38	56.90	3.53	2
43	005	River Chub	<i>Nocomis micropogon</i>	I	11	0.38	0.09	0.01	4
77	003	Rock Bass	<i>Ambloplites rupestris</i>		12	0.38	0.59	0.04	4
70	001	Brook Silverside	<i>Labidesthes sicculus</i>	M	10	0.31	0.01	0.00	3
47	007	Flathead Catfish	<i>Pylodictis olivaris</i>		10	0.31	7.80	0.48	4
40	018	Spotted Sucker	<i>Minytrema melanops</i>		10	0.31	3.51	0.22	1
85	001	Freshwater Drum	<i>Aplodinotus grunniens</i>	P	8	0.25	46.00	2.85	1
80	014	Johnny Darter	<i>Etheostoma nigrum</i>		6	0.25	0.01	0.00	3
47	008	Stonecat Madtom	<i>Noturus flavus</i>	I	8	0.25	0.20	0.01	3
74	005	Striped Bass X White Bass	<i>HYBRID</i>		8	0.25	2.85	0.18	3
80	015	Greenside Darter	<i>Etheostoma blennioides</i>	M	3	0.13	0.01	0.00	2
40	023	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	M	4	0.13	6.35	0.39	1
74	001	White Bass	<i>Morone chrysops</i>		4	0.13	0.34	0.02	2
40	002	Bigmouth Buffalo	<i>Ictiobus cyprinellus</i>		2	0.06	5.60	0.35	1
40	022	Bigmouth X Smallmouth Buffalo	<i>HYBRID</i>		2	0.06	7.80	0.48	1
43	013	Creek Chub	<i>Semotilus atromaculatus</i>	T	1	0.06	0.01	0.00	1
77	005	Spotted Bass	<i>Micropterus punctulatus</i>		2	0.06	1.05	0.07	1
		44 native species; 1 non-native species; 4 hybrids							

Appendix Table B-3. Grand totals for fish species sampled by MBI between Greenlawn Dam and Circleville in 2022.

Family Code	Species Code	Common Name	Latin Name	Ohio Tolerance	Number/km	% by Number	Kg/km	% by Biomass	No. of Samples
43	020	Emerald Shiner	<i>Notropis atherinoides</i>		1887	14.05	3.51	0.07	34
43	009	Gravel Chub	<i>Erimystax x-punctata</i>	M	1125	8.05	4.70	0.09	28
40	023	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	M	860	6.22	561.26	10.72	33
40	004	Smallmouth Buffalo	<i>Ictiobus bubalus</i>		868	5.59	1358.35	25.93	41
40	006	River Carpsucker	<i>Carpiodes carpio carpio</i>		983	5.47	749.60	14.31	39
43	032	Spotfin Shiner	<i>Cyprinella spiloptera</i>		601	4.29	1.65	0.03	37
20	003	Gizzard Shad	<i>Dorosoma cepedianum</i>		581	4.19	37.57	0.72	35
40	015	Northern Hog Sucker	<i>Hypentelium nigricans</i>	M	486	3.53	99.20	1.89	34
43	015	Suckermouth Minnow	<i>Phenacobius mirabilis</i>		420	3.00	1.47	0.03	24
43	044	Central Stoneroller	<i>Campostoma anomalum</i>		414	2.97	1.51	0.03	25
40	010	Golden Redhorse	<i>Moxostoma erythrurum</i>	M	398	2.80	252.20	4.81	37
77	011	Longear Sunfish	<i>Lepomis megalotis</i>	M	353	2.54	4.89	0.09	30
43	034	Sand Shiner	<i>Miniellus stramineus</i>	M	315	2.27	0.52	0.01	25
77	009	Bluegill Sunfish	<i>Lepomis macrochirus</i>	P	326	2.23	5.42	0.10	38
77	004	Smallmouth Bass	<i>Micropterus dolomieu</i>	M	285	2.09	110.01	2.10	32
85	001	Freshwater Drum	<i>Aplodinotus grunniens</i>	P	286	2.07	340.98	6.51	37
77	005	Spotted Bass	<i>Micropterus punctulatus</i>		272	2.00	23.92	0.46	36
43	008	Streamline Chub	<i>Erimystax dissimilis</i>	R	263	1.90	1.94	0.04	31
80	011	Logperch	<i>Percina caprodes</i>	M	242	1.61	1.94	0.04	28
43	043	Bluntnose Minnow	<i>Pimephales notatus</i>	T	219	1.57	0.33	0.01	28
47	002	Channel Catfish	<i>Ictalurus punctatus</i>		211	1.53	246.90	4.71	35
43	007	Bigeye Chub	<i>Notropis amblops</i>	I	203	1.46	0.48	0.01	27
43	021	Silver Shiner	<i>Notropis photogenis</i>	I	233	1.39	0.90	0.02	27
43	031	Steelcolor Shiner	<i>Cyprinella whipplei</i>	P	190	1.36	0.78	0.01	19
43	001	Common Carp	<i>Cyprinus carpio</i>	T	180	1.30	432.53	8.26	31
43	035	Mimic Shiner	<i>Paranotropis volucellus</i>	I	146	1.06	0.16	0.00	19
80	016	Banded Darter	<i>Etheostoma zonale</i>	I	142	1.01	0.15	0.00	23
80	017	Variagate Darter	<i>Etheostoma variatum</i>	I	131	0.96	0.40	0.01	16
43	041	Bullhead Minnow	<i>Pimephales vigilax</i>		127	0.91	0.26	0.00	20

Appendix Table B-3 . continued.

Family Code	Species Code	Common Name	Latin Name	Ohio Tolerance	Number/km	% by Number	Kg/km	% by Biomass	No. of Samples
43	020	Emerald Shiner	<i>Notropis atherinoides</i>		1887	14.05	3.51	0.07	34
43	009	Gravel Chub	<i>Erimystax x-punctata</i>	M	1125	8.05	4.70	0.09	28
40	023	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	M	860	6.22	561.26	10.72	33
40	004	Smallmouth Buffalo	<i>Ictiobus bubalus</i>		868	5.59	1358.35	25.93	41
40	006	River Carpsucker	<i>Carpionodes carpio carpio</i>		983	5.47	749.60	14.31	39
43	032	Spotfin Shiner	<i>Cyprinella spiloptera</i>		601	4.29	1.65	0.03	37
20	003	Gizzard Shad	<i>Dorosoma cepedianum</i>		581	4.19	37.57	0.72	35
40	015	Northern Hog Sucker	<i>Hypentelium nigricans</i>	M	486	3.53	99.20	1.89	34
43	015	Suckermouth Minnow	<i>Phenacobius mirabilis</i>		420	3.00	1.47	0.03	24
43	044	Central Stoneroller	<i>Campostoma anomalum</i>		414	2.97	1.51	0.03	25
40	010	Golden Redhorse	<i>Moxostoma erythrurum</i>	M	398	2.80	252.20	4.81	37
77	011	Longear Sunfish	<i>Lepomis megalotis</i>	M	353	2.54	4.89	0.09	30
43	034	Sand Shiner	<i>Miniellus stramineus</i>	M	315	2.27	0.52	0.01	25
77	009	Bluegill Sunfish	<i>Lepomis macrochirus</i>	P	326	2.23	5.42	0.10	38
77	004	Smallmouth Bass	<i>Micropterus dolomieu</i>	M	285	2.09	110.01	2.10	32
85	001	Freshwater Drum	<i>Aplodinotus grunniens</i>	P	286	2.07	340.98	6.51	37
77	005	Spotted Bass	<i>Micropterus punctulatus</i>		272	2.00	23.92	0.46	36
43	008	Streamline Chub	<i>Erimystax dissimilis</i>	R	263	1.90	1.94	0.04	31
80	011	Logperch	<i>Percina caprodes</i>	M	242	1.61	1.94	0.04	28
43	043	Bluntnose Minnow	<i>Pimephales notatus</i>	T	219	1.57	0.33	0.01	28
47	002	Channel Catfish	<i>Ictalurus punctatus</i>		211	1.53	246.90	4.71	35
43	007	Bigeye Chub	<i>Notropis amblops</i>	I	203	1.46	0.48	0.01	27
43	021	Silver Shiner	<i>Notropis photogenis</i>	I	233	1.39	0.90	0.02	27
43	031	Steelcolor Shiner	<i>Cyprinella whipplei</i>	P	190	1.36	0.78	0.01	19
43	001	Common Carp	<i>Cyprinus carpio</i>	T	180	1.30	432.53	8.26	31
43	035	Mimic Shiner	<i>Paranotropis volucellus</i>	I	146	1.06	0.16	0.00	19
80	016	Banded Darter	<i>Etheostoma zonale</i>	I	142	1.01	0.15	0.00	23
80	017	Variagate Darter	<i>Etheostoma variatum</i>	I	131	0.96	0.40	0.01	16
43	041	Bullhead Minnow	<i>Pimephales vigilax</i>		127	0.91	0.26	0.00	20
40	005	Quillback Carpsucker	<i>Carpionodes cyprinus</i>		142	0.90	115.30	2.20	24

Appendix Table B-3 . continued.

Family Code	Species Code	Common Name	Latin Name	Ohio Tolerance	Number/km	% by Number	Kg/km	% by Biomass	No. of Samples
43	020	Emerald Shiner	<i>Notropis atherinoides</i>		1887	14.05	3.51	0.07	34
43	009	Gravel Chub	<i>Erimystax x-punctata</i>	M	1125	8.05	4.70	0.09	28
40	023	Smallmouth Redhorse	<i>Moxostoma breviceps</i>	M	860	6.22	561.26	10.72	33
40	004	Smallmouth Buffalo	<i>Ictiobus bubalus</i>		868	5.59	1358.35	25.93	41
40	006	River Carpsucker	<i>Carpiodes carpio carpio</i>		983	5.47	749.60	14.31	39
43	032	Spotfin Shiner	<i>Cyprinella spiloptera</i>		601	4.29	1.65	0.03	37
20	003	Gizzard Shad	<i>Dorosoma cepedianum</i>		581	4.19	37.57	0.72	35
40	015	Northern Hog Sucker	<i>Hypentelium nigricans</i>	M	486	3.53	99.20	1.89	34
43	015	Suckermouth Minnow	<i>Phenacobius mirabilis</i>		420	3.00	1.47	0.03	24
43	044	Central Stoneroller	<i>Campostoma anomalum</i>		414	2.97	1.51	0.03	25
40	010	Golden Redhorse	<i>Moxostoma erythrurum</i>	M	398	2.80	252.20	4.81	37
77	011	Longear Sunfish	<i>Lepomis megalotis</i>	M	353	2.54	4.89	0.09	30
43	034	Sand Shiner	<i>Miniellus stramineus</i>	M	315	2.27	0.52	0.01	25
77	009	Bluegill Sunfish	<i>Lepomis macrochirus</i>	P	326	2.23	5.42	0.10	38
77	004	Smallmouth Bass	<i>Micropterus dolomieu</i>	M	285	2.09	110.01	2.10	32
85	001	Freshwater Drum	<i>Aplodinotus grunniens</i>	P	286	2.07	340.98	6.51	37
77	005	Spotted Bass	<i>Micropterus punctulatus</i>		272	2.00	23.92	0.46	36
43	008	Streamline Chub	<i>Erimystax dissimilis</i>	R	263	1.90	1.94	0.04	31
80	011	Logperch	<i>Percina caprodes</i>	M	242	1.61	1.94	0.04	28
43	043	Bluntnose Minnow	<i>Pimephales notatus</i>	T	219	1.57	0.33	0.01	28
47	002	Channel Catfish	<i>Ictalurus punctatus</i>		211	1.53	246.90	4.71	35
43	007	Bigeye Chub	<i>Notropis amblops</i>	I	203	1.46	0.48	0.01	27
43	021	Silver Shiner	<i>Notropis photogenis</i>	I	233	1.39	0.90	0.02	27
43	031	Steelcolor Shiner	<i>Cyprinella whipplei</i>	P	190	1.36	0.78	0.01	19
43	001	Common Carp	<i>Cyprinus carpio</i>	T	180	1.30	432.53	8.26	31
43	035	Mimic Shiner	<i>Paranotropis volucellus</i>	I	146	1.06	0.16	0.00	19
80	016	Banded Darter	<i>Etheostoma zonale</i>	I	142	1.01	0.15	0.00	23
80	017	Variagate Darter	<i>Etheostoma variatum</i>	I	131	0.96	0.40	0.01	16
43	041	Bullhead Minnow	<i>Pimephales vigilax</i>		127	0.91	0.26	0.00	20
40	005	Quillback Carpsucker	<i>Carpiodes cyprinus</i>		142	0.90	115.30	2.20	24

Appendix Table B-3 . continued.

80	026	Sauger X Walleye	<i>HYBRID</i>		119	0.86	69.08	1.32	25
77	008	Green Sunfish	<i>Lepomis cyanellus</i>	T	104	0.74	0.76	0.01	24
40	003	Black Buffalo	<i>Ictiobus niger</i>		110	0.67	273.50	5.22	20
80	020	Tippecanoe Darter	<i>Nothonotus tippecanoe</i>	R	85	0.61	0.06	0.00	18
77	006	Largemouth Bass	<i>Micropterus nigricans</i>		82	0.60	0.84	0.02	23
10	004	Longnose Gar	<i>Lepisosteus osseus</i>		76	0.54	42.77	0.82	21
80	001	Sauger	<i>Sander canadensis</i>		74	0.53	22.51	0.43	21
80	015	Greenside Darter	<i>Etheostoma blennioides</i>	M	73	0.53	0.17	0.00	16
80	019	Bluebreast Darter	<i>Nothonotus camurus</i>	R	70	0.50	0.12	0.00	12
40	008	Silver Redhorse	<i>Moxostoma anisurum</i>	M	67	0.49	131.10	2.50	24
43	022	Rosyface Shiner	<i>Notropis rubellus</i>	I	58	0.41	0.06	0.00	15
80	022	Rainbow Darter	<i>Etheostoma caeruleum</i>	M	46	0.33	0.05	0.00	15
43	025	Striped Shiner	<i>Luxilus chrysocephalus</i>		40	0.29	0.06	0.00	10
47	007	Flathead Catfish	<i>Pylodictis olivaris</i>		31	0.23	86.73	1.66	15
40	013	River Redhorse	<i>Moxostoma carinatum</i>	I	32	0.23	111.70	2.13	11
90	002	Mottled Sculpin	<i>Cottus bairdi</i>		30	0.21	0.05	0.00	10
18	002	Mooneye	<i>Hiodon tergisus</i>	R	28	0.20	6.13	0.12	12
80	007	Slenderhead Darter	<i>Percina phoxocephala</i>	R	24	0.17	0.02	0.00	6
80	014	Johnny Darter	<i>Etheostoma nigrum</i>		22	0.16	0.02	0.00	5
70	001	Brook Silverside	<i>Labidesthes sicculus</i>	M	20	0.14	0.02	0.00	8
77	010	Orangespotted Sunfish	<i>Lepomis humilis</i>		20	0.14	0.07	0.00	5
77	002	Black Crappie	<i>Pomoxis nigromaculatus</i>		17	0.13	2.94	0.06	8
43	023	Redfin Shiner	<i>Lythrurus umbratilis</i>		14	0.10	9.00	0.17	1
20	001	Skipjack Herring	<i>Alosa chrysochloris</i>		12	0.09	0.39	0.01	5
80	004	Ducky Darter	<i>Percina sciera sciera</i>	M	12	0.09	0.05	0.00	5
80	013	Eastern Sand Darter	<i>Ammocrypta pellucida</i>	R	10	0.07	0.01	0.00	3
40	002	Bigmouth Buffalo	<i>Ictiobus cyprinellus</i>		8	0.06	12.60	0.24	4
74	005	Striped Bass X White Bass	<i>HYBRID</i>		8	0.06	4.34	0.08	4
43	047	Grass Carp	<i>Ctenopharyngodon idella</i>		8	0.06	72.99	1.39	3
40	009	Black Redhorse	<i>Moxostoma duquesnei</i>	I	6	0.04	4.50	0.09	3
40	018	Spotted Sucker	<i>Minytrema melanops</i>		6	0.04	0.06	0.00	3
47	008	Stonecat	<i>Noturus flavus</i>	I	6	0.04	0.05	0.00	3

Appendix Table B-3 . continued.									
77	015	Green X Bluegill Sunfish	<i>HYBRID</i>		6	0.04	0.08	0.00	3
74	001	White Bass	<i>Morone chrysops</i>		6	0.04	1.07	0.02	2
43	005	River Chub	<i>Nocomis micropogon</i>	I	4	0.03	0.08	0.00	2
01	001	Silver Lamprey	<i>Ichthyomyzon unicuspis</i>		4	0.03	0.07	0.00	1
15	001	Bowfin	<i>Amia calva</i>		2	0.01	5.60	0.11	1
40	007	Highfin Carpsucker	<i>Carpionodes velifer</i>		2	0.01	1.60	0.03	1
40	022	Bigmouth X Smallmouth Buffalo	<i>HYBRID</i>		2	0.01	16.20	0.31	1
40	028	Quillback Carpsucker X Sm. Buffalo	<i>HYBRID</i>		2	0.01	1.50	0.03	1
43	002	Goldfish	<i>Carassius auratus</i>	T	2	0.01	0.00	0.00	1
43	003	Golden Shiner	<i>Notemigonus crysoleucas</i>	T	2	0.01	0.00	0.00	1
43	042	Fathead Minnow	<i>Pimephales promelas</i>	T	2	0.01	0.00	0.00	1
47	004	Yellow Bullhead	<i>Ameiurus natalis</i>	T	2	0.01	0.12	0.00	1
47	010	Northern Madtom	<i>Noturus stigmosus</i>	R	2	0.01	0.01	0.00	1
63	001	Trout-Perch	<i>Percopsis omiscomaycus</i>		2	0.01	0.00	0.00	1
80	005	Blackside Darter	<i>Percina maculata</i>		2	0.01	0.00	0.00	1
80	023	Orangethroat Darter	<i>Etheostoma spectabile</i>		2	0.01	0.00	0.00	1
Footnotes: I - Intolerant; R - Rare Intolerant; M - Moderately Intolerant; P -Moderately Tolerant; Highly Tolerant; blank cells are Intermediate tolerance									
71 native species; 2 non-native species; 5 hybrids									

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR01 River: 02-001 Scioto River RM: 136.05 Date: 08/17/2022
 Time Fished: 2482 Distance: 0.500 Drainge (sq mi): 1050.0 Depth: 0
 Location: Dst. 5th Ave. Lat: 39.98487 Long: -83.06611

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		24	48.0	11.01	1100	0.41	22.9
40-008	Silver Redhorse	I	M	S	R	5	10.0	2.29	26000	9.65	2600.0
40-009	Black Redhorse	I	I	S	R	1	2.0	0.46	600	0.22	300.0
40-010	Golden Redhorse	I	M	S	R	29	58.0	13.30	49800	18.48	858.6
40-013	River Redhorse	I	I	S	R	23	46.0	10.55	134300	49.84	2919.5
40-015	Northern Hog Sucker	I	M	S	R	3	6.0	1.38	2200	0.82	366.6
43-001	Common Carp	O	T	M	G	1	2.0	0.46	5600	2.08	2800.0
43-021	Silver Shiner	I	I	S	N	1	2.0	0.46	2	0.00	1.0
43-022	Rosyface Shiner	I	I	S	N	5	10.0	2.29	20	0.01	2.0
43-032	Spotfin Shiner	I		M	N	1	2.0	0.46	10	0.00	5.0
43-043	Bluntnose Minnow	O	T	C	N	6	12.0	2.75	10	0.00	0.8
43-044	Central Stoneroller	H		N	N	9	18.0	4.13	260	0.10	14.4
47-002	Channel Catfish			C	F	4	8.0	1.83	18100	6.72	2262.5
77-003	Rock Bass	C		C	S	1	2.0	0.46	50	0.02	25.0
77-004	Smallmouth Bass	C	M	C	F	23	46.0	10.55	16420	6.09	356.9
77-006	Largemouth Bass	C		C	F	11	22.0	5.05	130	0.05	5.9
77-008	Green Sunfish	I	T	C	S	18	36.0	8.26	320	0.12	8.8
77-009	Bluegill Sunfish	I	P	C	S	30	60.0	13.76	2300	0.85	38.3
77-010	Orangespotted Sunfish	I		C	S	4	8.0	1.83	40	0.01	5.0
77-011	Longear Sunfish	I	M	C	S	10	20.0	4.59	160	0.06	8.0
77-015	Green X Bluegill Sunfish					1	2.0	0.46	20	0.01	10.0
80-014	Johnny Darter	I		C	D	1	2.0	0.46	2	0.00	1.0
80-024	Fantail Darter	I		C	D	1	2.0	0.46	2	0.00	1.0
80-026	Sauger X Walleye	P			E	6	12.0	2.75	12000	4.45	1000.0

No Species: 21 **Nat. Species:** 21 **Hybrids:** 2 **Total Counted:** 218 **Total Rel. Wt. :** 269446
IBI: 46.0 **MIwb:** 9.6

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR02 River: 02-001 Scioto River RM: 133.40 Date: 08/11/2022
 Time Fished: 2496 Distance: 0.500 Drainge (sq mi): 1070.0 Depth: 0
 Location: dst. Dublin Rd Dam Lat: 39.96714 Long: -83.03408

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		5	10.0	4.59	1000	0.69	100.0
40-004	Smallmouth Buffalo	I		M	C	5	10.0	4.59	12100	8.39	1210.0
40-005	Quillback Carpsucker	O		M	C	3	6.0	2.75	2300	1.60	383.3
40-006	River Carpsucker	O		M	C	5	10.0	4.59	10600	7.35	1060.0
40-009	Black Redhorse	I	I	S	R	1	2.0	0.92	500	0.35	250.0
40-010	Golden Redhorse	I	M	S	R	12	24.0	11.01	12200	8.46	508.3
40-013	River Redhorse	I	I	S	R	3	6.0	2.75	15700	10.89	2616.6
40-022	Bigmouth Buffalo X Smallmouth Buffalo			M	C	1	2.0	0.92	7800	5.41	3900.0
43-001	Common Carp	O	T	M	G	10	20.0	9.17	26700	18.52	1335.0
43-021	Silver Shiner	I	I	S	N	2	4.0	1.83	4	0.00	1.0
43-022	Rosyface Shiner	I	I	S	N	1	2.0	0.92	4	0.00	2.0
43-032	Spotfin Shiner	I		M	N	7	14.0	6.42	84	0.06	6.0
43-044	Central Stoneroller	H		N	N	1	2.0	0.92	10	0.01	5.0
47-002	Channel Catfish			C	F	7	14.0	6.42	15050	10.44	1075.0
47-007	Flathead Catfish	P		C	F	1	2.0	0.92	4500	3.12	2250.0
70-001	Brook Silverside	I	M	M		2	4.0	1.83	2	0.00	0.5
77-002	Black Crappie	I		C	S	2	4.0	1.83	700	0.49	175.0
77-003	Rock Bass	C		C	S	2	4.0	1.83	340	0.24	85.0
77-004	Smallmouth Bass	C	M	C	F	7	14.0	6.42	1720	1.19	122.8
77-006	Largemouth Bass	C		C	F	6	12.0	5.50	80	0.06	6.6
77-008	Green Sunfish	I	T	C	S	3	6.0	2.75	90	0.06	15.0
77-009	Bluegill Sunfish	I	P	C	S	8	16.0	7.34	260	0.18	16.2
77-011	Longear Sunfish	I	M	C	S	4	8.0	3.67	60	0.04	7.5
77-015	Green X Bluegill Sunfish					1	2.0	0.92	70	0.05	35.0
80-011	Logperch	I	M	S	D	3	6.0	2.75	60	0.04	10.0
80-026	Sauger X Walleye	P			E	3	6.0	2.75	5000	3.47	833.3
85-001	Freshwater Drum		P	M		4	8.0	3.67	27200	18.87	3400.0

No Species: 23 **Nat. Species:** 23 **Hybrids:** 3 **Total Counted:** 109 **Total Rel. Wt. :** 144134
IBI: 44.0 **MIwb:** 9.6

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR03 River: 02-001 Scioto River RM: 133.00 Date: 08/11/2022
 Time Fished: 2072 Distance: 0.500 Drainge (sq mi): 1070.0 Depth: 0
 Location: dst. I-670 Lat: 39.96666 Long: -83.02674

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		5	10.0	3.76	1500	0.66	150.0
40-004	Smallmouth Buffalo	I		M	C	5	10.0	3.76	19200	8.43	1920.0
40-005	Quillback Carpsucker	O		M	C	1	2.0	0.75	1100	0.48	550.0
40-008	Silver Redhorse	I	M	S	R	4	8.0	3.01	15900	6.98	1987.5
40-009	Black Redhorse	I	I	S	R	2	4.0	1.50	2700	1.19	675.0
40-010	Golden Redhorse	I	M	S	R	22	44.0	16.54	22700	9.96	515.9
40-013	River Redhorse	I	I	S	R	18	36.0	13.53	87400	38.37	2427.7
40-015	Northern Hog Sucker	I	M	S	R	1	2.0	0.75	10	0.00	5.0
40-023	Smallmouth Redhorse	I	M	S	R	2	4.0	1.50	2950	1.30	737.5
43-001	Common Carp	O	T	M	G	4	8.0	3.01	38900	17.08	4862.5
43-005	River Chub	I	I	N	N	1	2.0	0.75	4	0.00	2.0
43-015	Suckermouth Minnow	I		S	N	3	6.0	2.26	40	0.02	6.6
43-021	Silver Shiner	I	I	S	N	1	2.0	0.75	4	0.00	2.0
43-032	Spotfin Shiner	I		M	N	1	2.0	0.75	10	0.00	5.0
43-034	Sand Shiner	I	I	M	N	12	24.0	9.02	70	0.03	2.9
43-044	Central Stoneroller	H		N	N	7	14.0	5.26	40	0.02	2.8
47-002	Channel Catfish			C	F	12	24.0	9.02	21900	9.61	912.5
47-007	Flathead Catfish	P		C	F	2	4.0	1.50	0	0.00	0.0
70-001	Brook Silverside	I	M	M		1	2.0	0.75	2	0.00	1.0
77-004	Smallmouth Bass	C	M	C	F	19	38.0	14.29	5420	2.38	142.6
77-008	Green Sunfish	I	T	C	S	1	2.0	0.75	10	0.00	5.0
80-011	Logperch	I	M	S	D	1	2.0	0.75	20	0.01	10.0
80-016	Banded Darter	I	I	S	D	1	2.0	0.75	4	0.00	2.0
80-019	Bluebreast Darter	I	R	S	D	1	2.0	0.75	6	0.00	3.0
80-024	Fantail Darter	I		C	D	2	4.0	1.50	8	0.00	2.0
80-026	Sauger X Walleye	P			E	4	8.0	3.01	7900	3.47	987.5

No Species: 24 **Nat. Species:** 24 **Hybrids:** 1 **Total Counted:** 133 **Total Rel. Wt. :** 227798
IBI: 52.0 **MIwb:** 9.6

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR04 River: 02-001 Scioto River RM: 132.10 Date: 08/11/2022
 Time Fished: 2074 Distance: 0.500 Drainge (sq mi): 1610.0 Depth: 0
 Location: dst. Olentangy Riveer Lat: 39.96438 Long: -83.01276

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		13	26.0	11.71	3700	5.91	142.3
40-004	Smallmouth Buffalo	I		M	C	3	6.0	2.70	4000	6.39	666.6
40-005	Quillback Carpsucker	O		M	C	3	6.0	2.70	2300	3.67	383.3
40-008	Silver Redhorse	I	M	S	R	3	6.0	2.70	10800	17.25	1800.0
40-010	Golden Redhorse	I	M	S	R	22	44.0	19.82	19200	30.67	436.3
43-001	Common Carp	O	T	M	G	2	4.0	1.80	11000	17.57	2750.0
43-032	Spotfin Shiner	I		M	N	1	2.0	0.90	6	0.01	3.0
43-043	Bluntnose Minnow	O	T	C	N	1	2.0	0.90	6	0.01	3.0
47-002	Channel Catfish			C	F	3	6.0	2.70	2300	3.67	383.3
74-001	White Bass	P		M	F	1	2.0	0.90	300	0.48	150.0
74-005	Striped Bass X White Bass				E	2	4.0	1.80	1800	2.88	450.0
77-002	Black Crappie	I		C	S	2	4.0	1.80	800	1.28	200.0
77-004	Smallmouth Bass	C	M	C	F	9	18.0	8.11	4740	7.57	263.3
77-006	Largemouth Bass	C		C	F	5	10.0	4.50	230	0.37	23.0
77-008	Green Sunfish	I	T	C	S	5	10.0	4.50	90	0.14	9.0
77-009	Bluegill Sunfish	I	P	C	S	13	26.0	11.71	560	0.89	21.5
77-010	Orangespotted Sunfish	I		C	S	5	10.0	4.50	70	0.11	7.0
77-011	Longear Sunfish	I	M	C	S	17	34.0	15.32	630	1.01	18.5
77-015	Green X Bluegill Sunfish					1	2.0	0.90	70	0.11	35.0

No Species: 16 **Nat. Species:** 16 **Hybrids:** 2 **Total Counted:** 111 **Total Rel. Wt. :** 62602
IBI: 42.0 **MIwb:** 8.7

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR05 River: 02-001 Scioto River RM: 130.40 Date: 08/11/2022
 Time Fished: 2736 Distance: 0.500 Drainge (sq mi): 1620.0 Depth: 0
 Location: ust. Greenlawn Dam Lat: 39.95000 Long: -83.01349

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		17	34.0	13.71	2300	3.26	67.6
40-002	Bigmouth Buffalo	I		M	C	1	2.0	0.81	5600	7.93	2800.0
40-004	Smallmouth Buffalo	I		M	C	12	24.0	9.68	20460	28.98	852.5
40-006	River Carpsucker	O		M	C	1	2.0	0.81	500	0.71	250.0
40-010	Golden Redhorse	I	M	S	R	12	24.0	9.68	9700	13.74	404.1
40-018	Spotted Sucker	I		S	R	5	10.0	4.03	3500	4.96	350.0
43-001	Common Carp	O	T	M	G	11	22.0	8.87	21500	30.45	977.2
43-041	Bullhead Minnow	O		C	N	9	18.0	7.26	40	0.06	2.2
43-043	Bluntnose Minnow	O	T	C	N	5	10.0	4.03	30	0.04	3.0
47-002	Channel Catfish			C	F	1	2.0	0.81	3500	4.96	1750.0
74-001	White Bass	P		M	F	1	2.0	0.81	40	0.06	20.0
77-005	Spotted Bass	C		C	F	1	2.0	0.81	1050	1.49	525.0
77-006	Largemouth Bass	C		C	F	9	18.0	7.26	1070	1.52	59.4
77-008	Green Sunfish	I	T	C	S	4	8.0	3.23	40	0.06	5.0
77-009	Bluegill Sunfish	I	P	C	S	18	36.0	14.52	620	0.88	17.2
77-010	Orangespotted Sunfish	I		C	S	2	4.0	1.61	40	0.06	10.0
77-011	Longear Sunfish	I	M	C	S	11	22.0	8.87	220	0.31	10.0
77-015	Green X Bluegill Sunfish					4	8.0	3.23	400	0.57	50.0

No Species: 16 **Nat. Species:** 16 **Hybrids:** 1 **Total Counted:** 124 **Total Rel. Wt. :** 70610

IBI: 36.0 **MIwb:** 8.4

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR06 River: 02-001 Scioto River RM: 129.40 Date: 08/18/2022
 Time Fished: 2689 Distance: 0.500 Drainge (sq mi): 1620.0 Depth: 0
 Location: dst. Greenlawn Ave. Lat: 39.93849 Long: -82.99965

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		1	2.0	0.50	0	0.00	0.0
20-003	Gizzard Shad	O		M		11	22.0	5.45	1460	1.49	66.3
40-004	Smallmouth Buffalo	I		M	C	9	18.0	4.46	21600	22.01	1200.0
40-005	Quillback Carpsucker	O		M	C	2	4.0	0.99	2900	2.96	725.0
40-006	River Carpsucker	O		M	C	19	38.0	9.41	29200	29.76	768.4
40-008	Silver Redhorse	I	M	S	R	2	4.0	0.99	8000	8.15	2000.0
40-010	Golden Redhorse	I	M	S	R	9	18.0	4.46	8100	8.25	450.0
40-013	River Redhorse	I	I	S	R	1	2.0	0.50	7400	7.54	3700.0
40-015	Northern Hog Sucker	I	M	S	R	4	8.0	1.98	1750	1.78	218.7
40-018	Spotted Sucker	I		S	R	1	2.0	0.50	10	0.01	5.0
40-023	Smallmouth Redhorse	I	M	S	R	3	6.0	1.49	3400	3.47	566.6
43-009	Gravel Chub	I	M	S	N	4	8.0	1.98	40	0.04	5.0
43-015	Suckermouth Minnow	I		S	N	1	2.0	0.50	6	0.01	3.0
43-020	Emerald Shiner	I		M	N	41	82.0	20.30	80	0.08	0.9
43-021	Silver Shiner	I	I	S	N	2	4.0	0.99	8	0.01	2.0
43-022	Rosyface Shiner	I	I	S	N	3	6.0	1.49	4	0.00	0.6
43-031	Steelcolor Shiner	I	P	M	N	14	28.0	6.93	100	0.10	3.5
43-032	Spotfin Shiner	I		M	N	17	34.0	8.42	100	0.10	2.9
43-034	Sand Shiner	I	I	M	N	3	6.0	1.49	10	0.01	1.6
43-035	Mimic Shiner	I	I	M	N	1	2.0	0.50	4	0.00	2.0
43-041	Bullhead Minnow	O		C	N	7	14.0	3.47	24	0.02	1.7
43-043	Bluntnose Minnow	O	T	C	N	6	12.0	2.97	10	0.01	0.8
47-002	Channel Catfish			C	F	1	2.0	0.50	2	0.00	1.0
77-004	Smallmouth Bass	C	M	C	F	4	8.0	1.98	4704	4.79	588.0
77-006	Largemouth Bass	C		C	F	3	6.0	1.49	20	0.02	3.3
77-009	Bluegill Sunfish	I	P	C	S	4	8.0	1.98	160	0.16	20.0
77-010	Orangespotted Sunfish	I		C	S	2	4.0	0.99	20	0.02	5.0
77-011	Longear Sunfish	I	M	C	S	2	4.0	0.99	30	0.03	7.5
80-001	Sauger	P		S	F	1	2.0	0.50	500	0.51	250.0
80-007	Slenderhead Darter	I	R	S	D	3	6.0	1.49	20	0.02	3.3
80-011	Loggerhead	I	M	S	D	6	12.0	2.97	140	0.14	11.6
80-016	Banded Darter	I	I	S	D	2	4.0	0.99	4	0.00	1.0
80-019	Bluebreast Darter	I	R	S	D	1	2.0	0.50	8	0.01	4.0
80-020	Tippecanoe Darter	I	R	S	D	5	10.0	2.48	6	0.01	0.6
80-022	Rainbow Darter	I	M	S	D	1	2.0	0.50	4	0.00	2.0
80-026	Sauger X Walleye	P			E	4	8.0	1.98	2300	2.34	287.5
85-001	Freshwater Drum		P	M		2	4.0	0.99	6000	6.11	1500.0

No Species: 35 **Nat. Species:** 36 **Hybrids:** 1 **Total Counted:** 202 **Total Rel. Wt. :** 98124
IBI: 46.0 **MIwb:** 10.1

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR06 River: 02-001 Scioto River RM: 129.40 Date: 09/16/2022
 Time Fished: 2591 Distance: 0.500 Drainge (sq mi): 1620.0 Depth: 0
 Location: dst. Greenlawn Ave. Lat: 39.93849 Long: -82.99965

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		1	2.0	0.96	900	1.17	450.0
20-001	Skipjack Herring	P		M		2	4.0	1.92	600	0.78	150.0
20-003	Gizzard Shad	O		M		1	2.0	0.96	60	0.08	30.0
40-004	Smallmouth Buffalo	I		M	C	5	10.0	4.81	19600	25.47	1960.0
40-006	River Carpsucker	O		M	C	10	20.0	9.62	16600	21.57	830.0
40-010	Golden Redhorse	I	M	S	R	3	6.0	2.88	3000	3.90	500.0
40-015	Northern Hog Sucker	I	M	S	R	3	6.0	2.88	1440	1.87	240.0
43-001	Common Carp	O	T	M	G	1	2.0	0.96	4800	6.24	2400.0
43-002	Goldfish	O	T	M	G	1	2.0	0.96	1300	1.69	650.0
43-007	Bigeye Chub	I	I	S	N	2	4.0	1.92	8	0.01	2.0
43-015	Suckermouth Minnow	I		S	N	1	2.0	0.96	10	0.01	5.0
43-021	Silver Shiner	I	I	S	N	1	2.0	0.96	2	0.00	1.0
43-031	Steelcolor Shiner	I	P	M	N	2	4.0	1.92	16	0.02	4.0
43-032	Spotfin Shiner	I		M	N	5	10.0	4.81	20	0.03	2.0
43-035	Mimic Shiner	I	I	M	N	2	4.0	1.92	4	0.01	1.0
43-043	Bluntnose Minnow	O	T	C	N	1	2.0	0.96	2	0.00	1.0
47-002	Channel Catfish			C	F	1	2.0	0.96	3900	5.07	1950.0
70-001	Brook Silverside	I	M	M		1	2.0	0.96	2	0.00	1.0
77-002	Black Crappie	I		C	S	1	2.0	0.96	60	0.08	30.0
77-004	Smallmouth Bass	C	M	C	F	7	14.0	6.73	6000	7.80	428.5
77-006	Largemouth Bass	C		C	F	1	2.0	0.96	20	0.03	10.0
77-009	Bluegill Sunfish	I	P	C	S	10	20.0	9.62	960	1.25	48.0
77-011	Longear Sunfish	I	M	C	S	6	12.0	5.77	180	0.23	15.0
80-001	Sauger	P		S	F	1	2.0	0.96	400	0.52	200.0
80-007	Slenderhead Darter	I	R	S	D	5	10.0	4.81	26	0.03	2.6
80-011	Logperch	I	M	S	D	9	18.0	8.65	120	0.16	6.6
80-016	Banded Darter	I	I	S	D	1	2.0	0.96	4	0.01	2.0
80-019	Bluebreast Darter	I	R	S	D	7	14.0	6.73	20	0.03	1.4
80-020	Tippecanoe Darter	I	R	S	D	3	6.0	2.88	6	0.01	1.0
80-026	Sauger X Walleye	P			E	6	12.0	5.77	4100	5.33	341.6
85-001	Freshwater Drum		P	M		4	8.0	3.85	12800	16.63	1600.0

No Species: 29 **Nat. Species:** 28 **Hybrids:** 1 **Total Counted:** 104 **Total Rel. Wt. :** 76960
IBI: 48.0 **MIwb:** 9.6

Appendix Table B-4. Midwest Biodiversity Institute

Fish Species List

Site ID: SR07 River: 02-001 Scioto River RM: 127.70 Date: 08/18/2022

Time Fished: 2836 Distance: 0.500 Drainge (sq mi): 1620.0 Depth: 0

Location: dst. St. Rte. 104 Lat: 39.91684 Long: -83.00939

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		1	2.0	0.36	600	0.28	300.0
20-001	Skipjack Herring	P		M		1	2.0	0.36	60	0.03	30.0
20-003	Gizzard Shad	O		M		9	18.0	3.26	200	0.09	11.1
40-002	Bigmouth Buffalo	I		M	C	1	2.0	0.36	2200	1.01	1100.0
40-003	Black Buffalo	I		M	C	2	4.0	0.72	9200	4.22	2300.0
40-004	Smallmouth Buffalo	I		M	C	40	80.0	14.49	94800	43.45	1185.0
40-005	Quillback Carpsucker	O		M	C	2	4.0	0.72	3500	1.60	875.0
40-006	River Carpsucker	O		M	C	11	22.0	3.99	14400	6.60	654.5
40-010	Golden Redhorse	I	M	S	R	20	40.0	7.25	28300	12.97	707.5
40-015	Northern Hog Sucker	I	M	S	R	3	6.0	1.09	1500	0.69	250.0
40-023	Smallmouth Redhorse	I	M	S	R	2	4.0	0.72	1900	0.87	475.0
43-001	Common Carp	O	T	M	G	11	22.0	3.99	19700	9.03	895.4
43-008	Streamline Chub	I	R	S	N	4	8.0	1.45	70	0.03	8.7
43-009	Gravel Chub	I	M	S	N	3	6.0	1.09	20	0.01	3.3
43-015	Suckermouth Minnow	I		S	N	3	6.0	1.09	20	0.01	3.3
43-020	Emerald Shiner	I		M	N	9	18.0	3.26	10	0.00	0.5
43-021	Silver Shiner	I	I	S	N	2	4.0	0.72	10	0.00	2.5
43-031	Steelcolor Shiner	I	P	M	N	19	38.0	6.88	98	0.04	2.5
43-032	Spotfin Shiner	I		M	N	40	80.0	14.49	220	0.10	2.7
43-035	Mimic Shiner	I	I	M	N	4	8.0	1.45	8	0.00	1.0
43-041	Bullhead Minnow	O		C	N	6	12.0	2.17	24	0.01	2.0
43-043	Bluntnose Minnow	O	T	C	N	5	10.0	1.81	6	0.00	0.6
43-044	Central Stoneroller	H		N	N	1	2.0	0.36	10	0.00	5.0
47-002	Channel Catfish			C	F	3	6.0	1.09	3700	1.70	616.6
70-001	Brook Silverside	I	M	M		2	4.0	0.72	2	0.00	0.5
77-002	Black Crappie	I		C	S	1	2.0	0.36	250	0.11	125.0
77-004	Smallmouth Bass	C	M	C	F	5	10.0	1.81	2070	0.95	207.0
77-005	Spotted Bass	C		C	F	1	2.0	0.36	1000	0.46	500.0
77-006	Largemouth Bass	C		C	F	2	4.0	0.72	30	0.01	7.5
77-008	Green Sunfish	I	T	C	S	1	2.0	0.36	20	0.01	10.0
77-009	Bluegill Sunfish	I	P	C	S	6	12.0	2.17	340	0.16	28.3
77-011	Longear Sunfish	I	M	C	S	17	34.0	6.16	380	0.17	11.1
80-001	Sauger	P		S	F	4	8.0	1.45	1750	0.80	218.7
80-007	Slenderhead Darter	I	R	S	D	1	2.0	0.36	4	0.00	2.0
80-011	Logperch	I	M	S	D	5	10.0	1.81	70	0.03	7.0
80-015	Greenside Darter	I	M	S	D	2	4.0	0.72	4	0.00	1.0
80-016	Banded Darter	I	I	S	D	3	6.0	1.09	8	0.00	1.3
80-019	Bluebreast Darter	I	R	S	D	7	14.0	2.54	22	0.01	1.5
80-020	Tippecanoe Darter	I	R	S	D	2	4.0	0.72	4	0.00	1.0
80-022	Rainbow Darter	I	M	S	D	2	4.0	0.72	4	0.00	1.0

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR07 River: 02-001 Scioto River RM: 127.70 Date: 08/18/2022
 Time Fished: 2836 Distance: 0.500 Drainge (sq mi): 1620.0 Depth: 0
 Location: dst. St. Rte. 104 Lat: 39.91684 Long: -83.00939

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
80-026	Sauger X Walleye	P			E	5	10.0	1.81	4200	1.93	420.0
85-001	Freshwater Drum		P	M		8	16.0	2.90	27450	12.58	1715.6

No Species: 40 **Nat. Species:** 40 **Hybrids:** 1 **Total Counted:** 276 **Total Rel. Wt. :** 218164
IBI: 50.0 **MIwb:** 10.6

Appendix Table B-4. Midwest Biodiversity Institute

Fish Species List

Site ID: SR07 River: 02-001 Scioto River RM: 127.70 Date: 09/16/2022

Time Fished: 2435 Distance: 0.500 Drainge (sq mi): 1620.0 Depth: 0

Location: dst. St. Rte. 104 Lat: 39.91684 Long: -83.00939

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		3	6.0	1.07	3600	1.89	600.0
20-003	Gizzard Shad	O		M		3	6.0	1.07	1200	0.63	200.0
40-003	Black Buffalo	I		M	C	1	2.0	0.36	8800	4.61	4400.0
40-004	Smallmouth Buffalo	I		M	C	34	68.0	12.14	83300	43.63	1225.0
40-006	River Carpsucker	O		M	C	20	40.0	7.14	30600	16.03	765.0
40-010	Golden Redhorse	I	M	S	R	7	14.0	2.50	9200	4.82	657.1
40-015	Northern Hog Sucker	I	M	S	R	7	14.0	2.50	2410	1.26	172.1
40-023	Smallmouth Redhorse	I	M	S	R	3	6.0	1.07	4200	2.20	700.0
43-001	Common Carp	O	T	M	G	3	6.0	1.07	17700	9.27	2950.0
43-005	River Chub	I	I	N	N	1	2.0	0.36	6	0.00	3.0
43-007	Bigeye Chub	I	I	S	N	2	4.0	0.71	6	0.00	1.5
43-008	Streamline Chub	I	R	S	N	9	18.0	3.21	160	0.08	8.8
43-009	Gravel Chub	I	M	S	N	6	12.0	2.14	60	0.03	5.0
43-015	Suckermouth Minnow	I		S	N	2	4.0	0.71	10	0.01	2.5
43-020	Emerald Shiner	I		M	N	29	58.0	10.36	100	0.05	1.7
43-021	Silver Shiner	I	I	S	N	5	10.0	1.79	60	0.03	6.0
43-022	Rosyface Shiner	I	I	S	N	1	2.0	0.36	2	0.00	1.0
43-031	Steelcolor Shiner	I	P	M	N	19	38.0	6.79	140	0.07	3.6
43-032	Spotfin Shiner	I		M	N	18	36.0	6.43	80	0.04	2.2
43-034	Sand Shiner	I	I	M	N	4	8.0	1.43	16	0.01	2.0
43-035	Mimic Shiner	I	I	M	N	7	14.0	2.50	24	0.01	1.7
43-041	Bullhead Minnow	O		C	N	10	20.0	3.57	26	0.01	1.3
43-043	Bluntnose Minnow	O	T	C	N	13	26.0	4.64	20	0.01	0.7
47-002	Channel Catfish			C	F	3	6.0	1.07	4700	2.46	783.3
70-001	Brook Silverside	I	M	M		1	2.0	0.36	2	0.00	1.0
77-004	Smallmouth Bass	C	M	C	F	4	8.0	1.43	160	0.08	20.0
77-008	Green Sunfish	I	T	C	S	1	2.0	0.36	10	0.01	5.0
77-009	Bluegill Sunfish	I	P	C	S	6	12.0	2.14	300	0.16	25.0
77-010	Orangespotted Sunfish	I		C	S	2	4.0	0.71	20	0.01	5.0
77-011	Longear Sunfish	I	M	C	S	25	50.0	8.93	590	0.31	11.8
80-001	Sauger	P		S	F	5	10.0	1.79	3000	1.57	300.0
80-011	Logperch	I	M	S	D	10	20.0	3.57	160	0.08	8.0
80-015	Greenside Darter	I	M	S	D	1	2.0	0.36	4	0.00	2.0
80-016	Banded Darter	I	I	S	D	1	2.0	0.36	2	0.00	1.0
80-019	Bluebreast Darter	I	R	S	D	2	4.0	0.71	6	0.00	1.5
80-022	Rainbow Darter	I	M	S	D	1	2.0	0.36	4	0.00	2.0
80-026	Sauger X Walleye	P			E	3	6.0	1.07	1130	0.59	188.3
85-001	Freshwater Drum		P	M		8	16.0	2.86	19100	10.00	1193.7

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

No Species: 36	Nat. Species: 36	Hybrids: 1	Total Counted: 280	Total Rel. Wt. : 190908
IBI: 48.0	MIwb: 10.6			

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR08.2 River: 02-001 Scioto River RM: 127.40 Date: 08/18/2022

Time Fished: 2018 Distance: 0.500 Drainge (sq mi): 1620.0 Depth: 0

Location: ust. Jackson Pike WWTP Lat: 39.91177 Long: -83.01033

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		1	2.0	0.58	1000	0.62	500.0
20-003	Gizzard Shad	O		M		22	44.0	12.79	460	0.28	10.4
40-003	Black Buffalo	I		M	C	1	2.0	0.58	3400	2.10	1700.0
40-004	Smallmouth Buffalo	I		M	C	19	38.0	11.05	49200	30.36	1294.7
40-006	River Carpsucker	O		M	C	40	80.0	23.26	59500	36.72	743.7
40-010	Golden Redhorse	I	M	S	R	2	4.0	1.16	3300	2.04	825.0
40-015	Northern Hog Sucker	I	M	S	R	1	2.0	0.58	1300	0.80	650.0
43-001	Common Carp	O	T	M	G	12	24.0	6.98	25400	15.67	1058.3
43-020	Emerald Shiner	I		M	N	2	4.0	1.16	4	0.00	1.0
43-021	Silver Shiner	I	I	S	N	15	30.0	8.72	60	0.04	2.0
43-025	Striped Shiner	I		S	N	1	2.0	0.58	2	0.00	1.0
43-032	Spotfin Shiner	I		M	N	4	8.0	2.33	20	0.01	2.5
43-035	Mimic Shiner	I	I	M	N	3	6.0	1.74	8	0.00	1.3
43-041	Bullhead Minnow	O		C	N	3	6.0	1.74	6	0.00	1.0
43-043	Bluntnose Minnow	O	T	C	N	11	22.0	6.40	40	0.02	1.8
47-002	Channel Catfish			C	F	6	12.0	3.49	6400	3.95	533.3
77-004	Smallmouth Bass	C	M	C	F	2	4.0	1.16	600	0.37	150.0
77-005	Spotted Bass	C		C	F	1	2.0	0.58	1200	0.74	600.0
77-006	Largemouth Bass	C		C	F	2	4.0	1.16	30	0.02	7.5
77-008	Green Sunfish	I	T	C	S	2	4.0	1.16	20	0.01	5.0
77-009	Bluegill Sunfish	I	P	C	S	3	6.0	1.74	180	0.11	30.0
77-011	Longear Sunfish	I	M	C	S	10	20.0	5.81	260	0.16	13.0
77-015	Green X Bluegill Sunfish					1	2.0	0.58	4	0.00	2.0
80-001	Sauger	P		S	F	1	2.0	0.58	600	0.37	300.0
80-011	Logperch	I	M	S	D	2	4.0	1.16	60	0.04	15.0
80-026	Sauger X Walleye	P			E	1	2.0	0.58	1000	0.62	500.0
85-001	Freshwater Drum		P	M		4	8.0	2.33	8000	4.94	1000.0

No Species: 24 **Nat. Species:** 24 **Hybrids:** 2 **Total Counted:** 172 **Total Rel. Wt. :** 162054

IBI: 32.0 **MIwb:** 9.4

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR08.2 River: 02-001 Scioto River RM: 127.40 Date: 09/16/2022
 Time Fished: 2140 Distance: 0.500 Drainge (sq mi): 1620.0 Depth: 0
 Location: ust. Jackson Pike WWTP Lat: 39.91177 Long: -83.01033

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
15-001	Bowfin	P		C		1	2.0	0.69	5600	4.52	2800.0
20-003	Gizzard Shad	O		M		8	16.0	5.52	1150	0.93	71.8
40-002	Bigmouth Buffalo	I		M	C	1	2.0	0.69	3800	3.07	1900.0
40-004	Smallmouth Buffalo	I		M	C	9	18.0	6.21	20400	16.46	1133.3
40-005	Quillback Carpsucker	O		M	C	1	2.0	0.69	1100	0.89	550.0
40-006	River Carpsucker	O		M	C	37	74.0	25.52	55900	45.09	755.4
40-010	Golden Redhorse	I	M	S	R	1	2.0	0.69	1100	0.89	550.0
40-028	Quillback Carpsucker X Smallm. Bullfalo			M	C	1	2.0	0.69	1500	1.21	750.0
43-001	Common Carp	O	T	M	G	1	2.0	0.69	2600	2.10	1300.0
43-008	Streamline Chub	I	R	S	N	2	4.0	1.38	20	0.02	5.0
43-009	Gravel Chub	I	M	S	N	1	2.0	0.69	6	0.00	3.0
43-020	Emerald Shiner	I		M	N	3	6.0	2.07	10	0.01	1.6
43-032	Spotfin Shiner	I		M	N	1	2.0	0.69	4	0.00	2.0
43-035	Mimic Shiner	I	I	M	N	2	4.0	1.38	6	0.00	1.5
43-041	Bullhead Minnow	O		C	N	5	10.0	3.45	20	0.02	2.0
43-043	Bluntnose Minnow	O	T	C	N	6	12.0	4.14	20	0.02	1.6
47-002	Channel Catfish			C	F	4	8.0	2.76	6800	5.49	850.0
47-007	Flathead Catfish	P		C	F	1	2.0	0.69	13900	11.21	6950.0
77-002	Black Crappie	I		C	S	1	2.0	0.69	300	0.24	150.0
77-004	Smallmouth Bass	C	M	C	F	1	2.0	0.69	10	0.01	5.0
77-005	Spotted Bass	C		C	F	3	6.0	2.07	420	0.34	70.0
77-006	Largemouth Bass	C		C	F	1	2.0	0.69	60	0.05	30.0
77-008	Green Sunfish	I	T	C	S	1	2.0	0.69	10	0.01	5.0
77-009	Bluegill Sunfish	I	P	C	S	13	26.0	8.97	1140	0.92	43.8
77-011	Longear Sunfish	I	M	C	S	24	48.0	16.55	480	0.39	10.0
77-015	Green X Bluegill Sunfish					1	2.0	0.69	10	0.01	5.0
80-001	Sauger	P		S	F	3	6.0	2.07	1500	1.21	250.0
80-011	Logperch	I	M	S	D	8	16.0	5.52	100	0.08	6.2
80-026	Sauger X Walleye	P			E	3	6.0	2.07	2600	2.10	433.3
85-001	Freshwater Drum		P	M		1	2.0	0.69	3400	2.74	1700.0

No Species: 26 **Nat. Species:** 26 **Hybrids:** 3 **Total Counted:** 145 **Total Rel. Wt. :** 123966
IBI: 40.0 **MIwb:** 9.3

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SRJPMZ River: 02-001 Scioto River RM: 127.00 Date: 08/18/2022

Time Fished: 589 Distance: 0.100 Drainge (sq mi): 1620.0 Depth: 0

Location: Jackson Pike WWTP mixing zone Lat: 39.90653 Long: -83.00819

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-003	Black Buffalo	I		M	C	2	20.0	5.41	41500	10.77	2075.0
40-004	Smallmouth Buffalo	I		M	C	8	80.0	21.62	137500	35.70	1718.7
40-005	Quillback Carpsucker	O		M	C	2	20.0	5.41	19000	4.93	950.0
40-006	River Carpsucker	O		M	C	20	200.0	54.05	187000	48.55	935.0
43-021	Silver Shiner	I	I	S	N	2	20.0	5.41	30	0.01	1.5
43-032	Spotfin Shiner	I		M	N	1	10.0	2.70	40	0.01	4.0
77-009	Bluegill Sunfish	I	P	C	S	2	20.0	5.41	100	0.03	5.0

No Species: 7 **Nat. Species:** 7 **Hybrids:** 0 **Total Counted:** 37 **Total Rel. Wt. :** 385170

IBI: 26.0 **MIwb:** 8.4

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SRJPMZ River: 02-001 Scioto River RM: 127.00 Date: 09/16/2022

Time Fished: 387 Distance: 0.100 Drainge (sq mi): 1620.0 Depth: 0

Location: Jackson Pike WWTP mixing zone Lat: 39.90653 Long: -83.00819

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-004	Smallmouth Buffalo	I		M	C	3	30.0	17.65	65000	45.61	2166.6
40-006	River Carpsucker	O		M	C	8	80.0	47.06	70500	49.47	881.2
40-010	Golden Redhorse	I	M	S	R	1	10.0	5.88	6500	4.56	650.0
43-021	Silver Shiner	I	I	S	N	3	30.0	17.65	150	0.11	5.0
80-011	Logperch	I	M	S	D	2	20.0	11.76	350	0.25	17.5
No Species: 5		Nat. Species: 5		Hybrids: 0		Total Counted: 17		Total Rel. Wt. : 142500			
IBI: 26.0		MIwb: 7.3									

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR08 River: 02-001 Scioto River RM: 126.55 Date: 08/31/2022
 Time Fished: 2029 Distance: 0.500 Drainge (sq mi): 1630.0 Depth: 0
 Location: dst. Jackson Pike WWTP Lat: 39.90166 Long: -83.00355

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		5	10.0	4.17	1100	1.04	110.0
40-003	Black Buffalo	I		M	C	3	6.0	2.50	17000	16.12	2833.3
40-004	Smallmouth Buffalo	I		M	C	6	12.0	5.00	23500	22.29	1958.3
40-006	River Carpsucker	O		M	C	5	10.0	4.17	8600	8.16	860.0
40-010	Golden Redhorse	I	M	S	R	2	4.0	1.67	4000	3.79	1000.0
40-015	Northern Hog Sucker	I	M	S	R	3	6.0	2.50	1800	1.71	300.0
40-023	Smallmouth Redhorse	I	M	S	R	12	24.0	10.00	15600	14.79	650.0
43-001	Common Carp	O	T	M	G	2	4.0	1.67	8200	7.78	2050.0
43-007	Bigeye Chub	I	I	S	N	1	2.0	0.83	4	0.00	2.0
43-009	Gravel Chub	I	M	S	N	1	2.0	0.83	20	0.02	10.0
43-020	Emerald Shiner	I		M	N	14	28.0	11.67	20	0.02	0.7
43-031	Steelcolor Shiner	I	P	M	N	2	4.0	1.67	10	0.01	2.5
43-032	Spotfin Shiner	I		M	N	4	8.0	3.33	10	0.01	1.2
43-035	Mimic Shiner	I	I	M	N	8	16.0	6.67	20	0.02	1.2
43-041	Bullhead Minnow	O		C	N	4	8.0	3.33	20	0.02	2.5
43-043	Bluntnose Minnow	O	T	C	N	14	28.0	11.67	50	0.05	1.7
43-044	Central Stoneroller	H		N	N	1	2.0	0.83	6	0.01	3.0
47-002	Channel Catfish			C	F	2	4.0	1.67	15800	14.98	3950.0
47-007	Flathead Catfish	P		C	F	1	2.0	0.83	4000	3.79	2000.0
63-001	Trout-Perch	I		M		1	2.0	0.83	6	0.01	3.0
70-001	Brook Silverside	I	M	M		2	4.0	1.67	4	0.00	1.0
77-004	Smallmouth Bass	C	M	C	F	3	6.0	2.50	1100	1.04	183.3
77-005	Spotted Bass	C		C	F	2	4.0	1.67	100	0.09	25.0
77-006	Largemouth Bass	C		C	F	4	8.0	3.33	20	0.02	2.5
77-008	Green Sunfish	I	T	C	S	1	2.0	0.83	10	0.01	5.0
77-009	Bluegill Sunfish	I	P	C	S	6	12.0	5.00	320	0.30	26.6
77-011	Longear Sunfish	I	M	C	S	7	14.0	5.83	190	0.18	13.5
80-011	Logperch	I	M	S	D	2	4.0	1.67	40	0.04	10.0
80-026	Sauger X Walleye	P			E	1	2.0	0.83	600	0.57	300.0
85-001	Freshwater Drum		P	M		1	2.0	0.83	3300	3.13	1650.0

No Species: 28 **Nat. Species:** 28 **Hybrids:** 1 **Total Counted:** 120 **Total Rel. Wt. :** 105450
IBI: 38.0 **MIwb:** 10.0

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR08 River: 02-001 Scioto River RM: 126.55 Date: 10/15/2022
 Time Fished: 2444 Distance: 0.500 Drainge (sq mi): 1630.0 Depth: 0
 Location: dst. Jackson Pike WWTP Lat: 39.90166 Long: -83.00355

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		1	2.0	1.01	20	0.02	10.0
40-004	Smallmouth Buffalo	I		M	C	3	6.0	3.03	16800	17.82	2800.0
40-006	River Carpsucker	O		M	C	3	6.0	3.03	5200	5.52	866.6
40-010	Golden Redhorse	I	M	S	R	2	4.0	2.02	4000	4.24	1000.0
40-015	Northern Hog Sucker	I	M	S	R	4	8.0	4.04	1560	1.65	195.0
40-018	Spotted Sucker	I		S	R	1	2.0	1.01	40	0.04	20.0
40-023	Smallmouth Redhorse	I	M	S	R	2	4.0	2.02	3200	3.39	800.0
43-001	Common Carp	O	T	M	G	2	4.0	2.02	18700	19.84	4675.0
43-007	Bigeye Chub	I	I	S	N	1	2.0	1.01	4	0.00	2.0
43-008	Streamline Chub	I	R	S	N	1	2.0	1.01	40	0.04	20.0
43-020	Emerald Shiner	I		M	N	18	36.0	18.18	90	0.10	2.5
43-022	Rosyface Shiner	I	I	S	N	1	2.0	1.01	4	0.00	2.0
43-031	Steelcolor Shiner	I	P	M	N	2	4.0	2.02	20	0.02	5.0
43-032	Spotfin Shiner	I		M	N	10	20.0	10.10	40	0.04	2.0
43-034	Sand Shiner	I	I	M	N	1	2.0	1.01	6	0.01	3.0
43-041	Bullhead Minnow	O		C	N	6	12.0	6.06	44	0.05	3.6
43-043	Bluntnose Minnow	O	T	C	N	2	4.0	2.02	6	0.01	1.5
43-044	Central Stoneroller	H		N	N	1	2.0	1.01	10	0.01	5.0
43-047	Grass Carp			M	E	1	2.0	1.01	20000	21.22	10000.0
47-007	Flathead Catfish	P		C	F	1	2.0	1.01	23000	24.40	11500.0
77-004	Smallmouth Bass	C	M	C	F	5	10.0	5.05	640	0.68	64.0
77-005	Spotted Bass	C		C	F	1	2.0	1.01	20	0.02	10.0
77-006	Largemouth Bass	C		C	F	3	6.0	3.03	70	0.07	11.6
77-008	Green Sunfish	I	T	C	S	1	2.0	1.01	40	0.04	20.0
77-009	Bluegill Sunfish	I	P	C	S	6	12.0	6.06	40	0.04	3.3
77-010	Orangespotted Sunfish	I		C	S	2	4.0	2.02	20	0.02	5.0
77-011	Longear Sunfish	I	M	C	S	6	12.0	6.06	40	0.04	3.3
80-001	Sauger	P		S	F	1	2.0	1.01	500	0.53	250.0
80-011	Logperch	I	M	S	D	3	6.0	3.03	60	0.06	10.0
80-015	Greenside Darter	I	M	S	D	1	2.0	1.01	6	0.01	3.0
80-016	Banded Darter	I	I	S	D	1	2.0	1.01	2	0.00	1.0
80-019	Bluebreast Darter	I	R	S	D	4	8.0	4.04	40	0.04	5.0
80-020	Tippecanoe Darter	I	R	S	D	2	4.0	2.02	2	0.00	0.5

No Species: 32 **Nat. Species:** 31 **Hybrids:** 0 **Total Counted:** 99 **Total Rel. Wt. :** 94264

IBI: 50.0 **MIwb:** 9.6

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR09 River: 02-001 Scioto River RM: 125.20 Date: 08/31/2022
 Time Fished: 2510 Distance: 0.500 Drainge (sq mi): 1640.0 Depth: 0
 Location: dst. American Aggregates Lat: 39.89037 Long: -83.01304

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		2	4.0	2.44	1300	1.15	325.0
20-003	Gizzard Shad	O		M		6	12.0	7.32	1900	1.68	158.3
40-004	Smallmouth Buffalo	I		M	C	11	22.0	13.41	28400	25.07	1290.9
40-006	River Carpsucker	O		M	C	24	48.0	29.27	35900	31.69	747.9
40-010	Golden Redhorse	I	M	S	R	2	4.0	2.44	2200	1.94	550.0
40-018	Spotted Sucker	I		S	R	1	2.0	1.22	20	0.02	10.0
43-001	Common Carp	O	T	M	G	7	14.0	8.54	28700	25.33	2050.0
43-041	Bullhead Minnow	O		C	N	1	2.0	1.22	4	0.00	2.0
47-002	Channel Catfish			C	F	2	4.0	2.44	2250	1.99	562.5
77-004	Smallmouth Bass	C	M	C	F	3	6.0	3.66	1340	1.18	223.3
77-005	Spotted Bass	C		C	F	1	2.0	1.22	1400	1.24	700.0
77-006	Largemouth Bass	C		C	F	1	2.0	1.22	10	0.01	5.0
77-008	Green Sunfish	I	T	C	S	2	4.0	2.44	40	0.04	10.0
77-009	Bluegill Sunfish	I	P	C	S	2	4.0	2.44	80	0.07	20.0
77-011	Longear Sunfish	I	M	C	S	7	14.0	8.54	250	0.22	17.8
80-001	Sauger	P		S	F	3	6.0	3.66	1900	1.68	316.6
80-011	Logperch	I	M	S	D	1	2.0	1.22	4	0.00	2.0
85-001	Freshwater Drum		P	M		6	12.0	7.32	7600	6.71	633.3

No Species: 17 **Nat. Species:** 17 **Hybrids:** 0 **Total Counted:** 82 **Total Rel. Wt. :** 113298

IBI: 32.0 **MIwb:** 8.5

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR09 River: 02-001 Scioto River RM: 125.20 Date: 10/15/2022
 Time Fished: 2525 Distance: 0.500 Drainge (sq mi): 1640.0 Depth: 0
 Location: dst. American Aggregates Lat: 39.89037 Long: -83.01304

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		1	2.0	1.06	900	0.84	450.0
20-003	Gizzard Shad	O		M		3	6.0	3.19	700	0.66	116.6
40-004	Smallmouth Buffalo	I		M	C	13	26.0	13.83	37300	34.92	1434.6
40-005	Quillback Carpsucker	O		M	C	3	6.0	3.19	4700	4.40	783.3
40-006	River Carpsucker	O		M	C	13	26.0	13.83	20500	19.19	788.4
40-007	Highfin Carpsucker	O		M	C	1	2.0	1.06	1600	1.50	800.0
40-008	Silver Redhorse	I	M	S	R	1	2.0	1.06	3800	3.56	1900.0
40-009	Black Redhorse	I	I	S	R	1	2.0	1.06	1600	1.50	800.0
40-010	Golden Redhorse	I	M	S	R	3	6.0	3.19	5700	5.34	950.0
40-023	Smallmouth Redhorse	I	M	S	R	2	4.0	2.13	3600	3.37	900.0
43-001	Common Carp	O	T	M	G	2	4.0	2.13	0	0.00	0.0
43-008	Streamline Chub	I	R	S	N	4	8.0	4.26	50	0.05	6.2
43-041	Bullhead Minnow	O		C	N	1	2.0	1.06	4	0.00	2.0
47-002	Channel Catfish			C	F	2	4.0	2.13	4950	4.63	1237.5
47-007	Flathead Catfish	P		C	F	1	2.0	1.06	3700	3.46	1850.0
77-004	Smallmouth Bass	C	M	C	F	1	2.0	1.06	20	0.02	10.0
77-005	Spotted Bass	C		C	F	11	22.0	11.70	680	0.64	30.9
77-008	Green Sunfish	I	T	C	S	3	6.0	3.19	80	0.07	13.3
77-009	Bluegill Sunfish	I	P	C	S	9	18.0	9.57	110	0.10	6.1
77-011	Longear Sunfish	I	M	C	S	10	20.0	10.64	340	0.32	17.0
80-001	Sauger	P		S	F	2	4.0	2.13	2900	2.72	725.0
80-022	Rainbow Darter	I	M	S	D	1	2.0	1.06	4	0.00	2.0
80-026	Sauger X Walleye	P			E	5	10.0	5.32	9570	8.96	957.0
85-001	Freshwater Drum		P	M		1	2.0	1.06	4000	3.75	2000.0

No Species: 22 **Nat. Species:** 22 **Hybrids:** 1 **Total Counted:** 94 **Total Rel. Wt. :** 106808
IBI: 40.0 **MIwb:** 9.3

Appendix Table B-4. Midwest Biodiversity Institute

Fish Species List

Site ID: SR10 River: 02-001 Scioto River RM: 124.40 Date: 08/31/2022

Time Fished: 2438 Distance: 0.500 Drainge (sq mi): 1670.0 Depth: 0

Location: dst. I-270 Lat: 39.87980 Long: -83.01849

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		3	6.0	1.80	3800	3.39	633.3
20-003	Gizzard Shad	O		M		3	6.0	1.80	1500	1.34	250.0
40-003	Black Buffalo	I		M	C	5	10.0	2.99	20800	18.54	2080.0
40-004	Smallmouth Buffalo	I		M	C	9	18.0	5.39	27700	24.69	1538.8
40-005	Quillback Carpsucker	O		M	C	4	8.0	2.40	5900	5.26	737.5
40-006	River Carpsucker	O		M	C	1	2.0	0.60	1800	1.60	900.0
40-010	Golden Redhorse	I	M	S	R	3	6.0	1.80	4100	3.65	683.3
40-015	Northern Hog Sucker	I	M	S	R	3	6.0	1.80	2300	2.05	383.3
40-023	Smallmouth Redhorse	I	M	S	R	6	12.0	3.59	8000	7.13	666.6
43-001	Common Carp	O	T	M	G	1	2.0	0.60	4000	3.56	2000.0
43-007	Bigeye Chub	I	I	S	N	1	2.0	0.60	4	0.00	2.0
43-008	Streamline Chub	I	R	S	N	1	2.0	0.60	6	0.01	3.0
43-009	Gravel Chub	I	M	S	N	12	24.0	7.19	130	0.12	5.4
43-015	Suckermouth Minnow	I		S	N	9	18.0	5.39	40	0.04	2.2
43-020	Emerald Shiner	I		M	N	25	50.0	14.97	84	0.07	1.6
43-022	Rosyface Shiner	I	I	S	N	2	4.0	1.20	4	0.00	1.0
43-031	Steelcolor Shiner	I	P	M	N	1	2.0	0.60	6	0.01	3.0
43-032	Spotfin Shiner	I		M	N	7	14.0	4.19	44	0.04	3.1
43-034	Sand Shiner	I	I	M	N	2	4.0	1.20	6	0.01	1.5
43-035	Mimic Shiner	I	I	M	N	14	28.0	8.38	30	0.03	1.0
43-041	Bullhead Minnow	O		C	N	4	8.0	2.40	22	0.02	2.7
43-043	Bluntnose Minnow	O	T	C	N	1	2.0	0.60	4	0.00	2.0
47-002	Channel Catfish			C	F	7	14.0	4.19	17200	15.33	1228.5
47-007	Flathead Catfish	P		C	F	1	2.0	0.60	400	0.36	200.0
77-004	Smallmouth Bass	C	M	C	F	3	6.0	1.80	1200	1.07	200.0
77-005	Spotted Bass	C		C	F	4	8.0	2.40	1700	1.52	212.5
77-006	Largemouth Bass	C		C	F	1	2.0	0.60	4	0.00	2.0
77-008	Green Sunfish	I	T	C	S	5	10.0	2.99	70	0.06	7.0
77-009	Bluegill Sunfish	I	P	C	S	10	20.0	5.99	350	0.31	17.5
77-011	Longear Sunfish	I	M	C	S	10	20.0	5.99	200	0.18	10.0
80-001	Sauger	P		S	F	2	4.0	1.20	1000	0.89	250.0
80-026	Sauger X Walleye	P			E	4	8.0	2.40	3600	3.21	450.0
85-001	Freshwater Drum		P	M		3	6.0	1.80	6200	5.53	1033.3

No Species: 31 **Nat. Species:** 31 **Hybrids:** 1 **Total Counted:** 167 **Total Rel. Wt. :** 112204

IBI: 50.0 **MIwb:** 10.4

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR10 River: 02-001 Scioto River RM: 124.40 Date: 10/15/2022
 Time Fished: 2594 Distance: 0.500 Drainge (sq mi): 1670.0 Depth: 0
 Location: dst. I-270 Lat: 39.87980 Long: -83.01849

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		1	2.0	0.67	1100	1.74	550.0
20-003	Gizzard Shad	O		M		7	14.0	4.70	2400	3.80	171.4
40-004	Smallmouth Buffalo	I		M	C	5	10.0	3.36	16600	26.31	1660.0
40-005	Quillback Carpsucker	O		M	C	5	10.0	3.36	8200	13.00	820.0
40-006	River Carpsucker	O		M	C	3	6.0	2.01	4700	7.45	783.3
40-010	Golden Redhorse	I	M	S	R	5	10.0	3.36	8800	13.95	880.0
40-015	Northern Hog Sucker	I	M	S	R	3	6.0	2.01	1450	2.30	241.6
40-023	Smallmouth Redhorse	I	M	S	R	4	8.0	2.68	6400	10.14	800.0
43-007	Bigeye Chub	I	I	S	N	1	2.0	0.67	4	0.01	2.0
43-008	Streamline Chub	I	R	S	N	1	2.0	0.67	20	0.03	10.0
43-009	Gravel Chub	I	M	S	N	8	16.0	5.37	90	0.14	5.6
43-015	Suckermouth Minnow	I		S	N	23	46.0	15.44	260	0.41	5.6
43-020	Emerald Shiner	I		M	N	46	92.0	30.87	280	0.44	3.0
43-021	Silver Shiner	I	I	S	N	1	2.0	0.67	20	0.03	10.0
43-022	Rosyface Shiner	I	I	S	N	4	8.0	2.68	20	0.03	2.5
43-031	Steelcolor Shiner	I	P	M	N	1	2.0	0.67	20	0.03	10.0
43-032	Spotfin Shiner	I		M	N	1	2.0	0.67	4	0.01	2.0
43-034	Sand Shiner	I	I	M	N	1	2.0	0.67	6	0.01	3.0
43-043	Bluntnose Minnow	O	T	C	N	1	2.0	0.67	2	0.00	1.0
47-002	Channel Catfish			C	F	2	4.0	1.34	1200	1.90	300.0
74-001	White Bass	P		M	F	1	2.0	0.67	600	0.95	300.0
77-004	Smallmouth Bass	C	M	C	F	5	10.0	3.36	3830	6.07	383.0
77-005	Spotted Bass	C		C	F	1	2.0	0.67	160	0.25	80.0
77-008	Green Sunfish	I	T	C	S	3	6.0	2.01	20	0.03	3.3
77-009	Bluegill Sunfish	I	P	C	S	1	2.0	0.67	10	0.02	5.0
77-011	Longear Sunfish	I	M	C	S	5	10.0	3.36	60	0.10	6.0
80-001	Sauger	P		S	F	2	4.0	1.34	1400	2.22	350.0
80-014	Johnny Darter	I		C	D	1	2.0	0.67	2	0.00	1.0
80-015	Greenside Darter	I	M	S	D	3	6.0	2.01	20	0.03	3.3
80-016	Banded Darter	I	I	S	D	1	2.0	0.67	2	0.00	1.0
85-001	Freshwater Drum		P	M		2	4.0	1.34	5400	8.56	1350.0
90-002	Mottled Sculpin	I		C		1	2.0	0.67	6	0.01	3.0

No Species: 31 **Nat. Species:** 32 **Hybrids:** 0 **Total Counted:** 149 **Total Rel. Wt. :** 63086
IBI: 50.0 **MIwb:** 9.7

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR11 River: 02-001 Scioto River RM: 120.10 Date: 08/08/2022
 Time Fished: 2766 Distance: 0.500 Drainge (sq mi): 1700.0 Depth: 0
 Location: at SR 665 Lat: 39.83378 Long: -83.00897

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		1	2.0	0.38	600	0.27	300.0
20-003	Gizzard Shad	O		M		46	92.0	17.69	1250	0.57	13.5
40-003	Black Buffalo	I		M	C	4	8.0	1.54	20300	9.23	2537.5
40-005	Quillback Carpsucker	O		M	C	3	6.0	1.15	4200	1.91	700.0
40-006	River Carpsucker	O		M	C	11	22.0	4.23	14700	6.68	668.1
40-008	Silver Redhorse	I	M	S	R	1	2.0	0.38	4100	1.86	2050.0
40-010	Golden Redhorse	I	M	S	R	4	8.0	1.54	3600	1.64	450.0
40-015	Northern Hog Sucker	I	M	S	R	1	2.0	0.38	10	0.00	5.0
40-023	Smallmouth Redhorse	I	M	S	R	23	46.0	8.85	32600	14.82	708.6
43-001	Common Carp	O	T	M	G	6	12.0	2.31	23300	10.59	1941.6
43-008	Streamline Chub	I	R	S	N	3	6.0	1.15	22	0.01	3.6
43-009	Gravel Chub	I	M	S	N	5	10.0	1.92	20	0.01	2.0
43-015	Suckermouth Minnow	I		S	N	4	8.0	1.54	16	0.01	2.0
43-020	Emerald Shiner	I		M	N	2	4.0	0.77	4	0.00	1.0
43-032	Spotfin Shiner	I		M	N	11	22.0	4.23	70	0.03	3.1
43-034	Sand Shiner	I	M	M	N	1	2.0	0.38	2	0.00	1.0
43-035	Mimic Shiner	I	I	M	N	4	8.0	1.54	6	0.00	0.7
43-041	Bullhead Minnow	O		C	N	1	2.0	0.38	8	0.00	4.0
43-042	Fathead Minnow	O	T	C	N	1	2.0	0.38	2	0.00	1.0
43-043	Bluntnose Minnow	O	T	C	N	5	10.0	1.92	28	0.01	2.8
43-044	Central Stoneroller	H		N	N	43	86.0	16.54	140	0.06	1.6
47-002	Channel Catfish			C	F	7	14.0	2.69	24100	10.96	1721.4
74-005	Striped Bass X White Bass				E	1	2.0	0.38	1200	0.55	600.0
77-004	Smallmouth Bass	C	M	C	F	28	56.0	10.77	77720	35.34	1387.8
77-005	Spotted Bass	C		C	F	6	12.0	2.31	1300	0.59	108.3
77-006	Largemouth Bass	C		C	F	3	6.0	1.15	140	0.06	23.3
77-008	Green Sunfish	I	T	C	S	2	4.0	0.77	10	0.00	2.5
77-009	Bluegill Sunfish	I	P	C	S	13	26.0	5.00	270	0.12	10.3
77-011	Longear Sunfish	I	M	C	S	4	8.0	1.54	300	0.14	37.5
80-011	Logperch	I	M	S	D	6	12.0	2.31	100	0.05	8.3
80-015	Greenside Darter	I	M	S	D	1	2.0	0.38	4	0.00	2.0
80-016	Banded Darter	I	I	S	D	2	4.0	0.77	4	0.00	1.0
80-022	Rainbow Darter	I	M	S	D	2	4.0	0.77	4	0.00	1.0
85-001	Freshwater Drum		P	M		5	10.0	1.92	9800	4.46	980.0

No Species: 32 **Nat. Species:** 32 **Hybrids:** 1 **Total Counted:** 260 **Total Rel. Wt. :** 219930

IBI: 44.0 **MIwb:** 10.5

Appendix Table B-4. Midwest Biodiversity Institute

Fish Species List

Site ID: SR11 River: 02-001 Scioto River RM: 120.10 Date: 09/13/2022

Time Fished: 2881 Distance: 0.500 Drainge (sq mi): 1700.0 Depth: 0

Location: at SR 665 Lat: 39.83378 Long: -83.00897

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		2	4.0	0.96	2800	1.57	700.0
20-003	Gizzard Shad	O		M		9	18.0	4.33	1800	1.01	100.0
40-003	Black Buffalo	I		M	C	2	4.0	0.96	6900	3.88	1725.0
40-004	Smallmouth Buffalo	I		M	C	18	36.0	8.65	50900	28.62	1413.8
40-005	Quillback Carpsucker	O		M	C	3	6.0	1.44	4900	2.76	816.6
40-006	River Carpsucker	O		M	C	10	20.0	4.81	15700	8.83	785.0
40-008	Silver Redhorse	I	M	S	R	2	4.0	0.96	7900	4.44	1975.0
40-010	Golden Redhorse	I	M	S	R	11	22.0	5.29	13600	7.65	618.1
40-015	Northern Hog Sucker	I	M	S	R	2	4.0	0.96	30	0.02	7.5
40-023	Smallmouth Redhorse	I	M	S	R	24	48.0	11.54	34000	19.12	708.3
43-001	Common Carp	O	T	M	G	8	16.0	3.85	19500	10.97	1218.7
43-007	Bigeye Chub	I	I	S	N	2	4.0	0.96	12	0.01	3.0
43-008	Streamline Chub	I	R	S	N	2	4.0	0.96	20	0.01	5.0
43-009	Gravel Chub	I	M	S	N	4	8.0	1.92	20	0.01	2.5
43-015	Suckermouth Minnow	I		S	N	2	4.0	0.96	6	0.00	1.5
43-020	Emerald Shiner	I		M	N	20	40.0	9.62	60	0.03	1.5
43-021	Silver Shiner	I	I	S	N	2	4.0	0.96	16	0.01	4.0
43-022	Rosyface Shiner	I	I	S	N	1	2.0	0.48	2	0.00	1.0
43-031	Steelcolor Shiner	I	P	M	N	3	6.0	1.44	40	0.02	6.6
43-032	Spotfin Shiner	I		M	N	8	16.0	3.85	60	0.03	3.7
43-035	Mimic Shiner	I	I	M	N	4	8.0	1.92	12	0.01	1.5
43-043	Bluntnose Minnow	O	T	C	N	1	2.0	0.48	6	0.00	3.0
43-044	Central Stoneroller	H		N	N	25	50.0	12.02	122	0.07	2.4
47-002	Channel Catfish			C	F	1	2.0	0.48	500	0.28	250.0
47-004	Yellow Bullhead	I	T	C		1	2.0	0.48	120	0.07	60.0
47-007	Flathead Catfish	P		C	F	1	2.0	0.48	500	0.28	250.0
70-001	Brook Silverside	I	M	M		1	2.0	0.48	2	0.00	1.0
74-005	Striped Bass X White Bass				E	1	2.0	0.48	40	0.02	20.0
77-004	Smallmouth Bass	C	M	C	F	3	6.0	1.44	360	0.20	60.0
77-005	Spotted Bass	C		C	F	5	10.0	2.40	1020	0.57	102.0
77-006	Largemouth Bass	C		C	F	1	2.0	0.48	10	0.01	5.0
77-008	Green Sunfish	I	T	C	S	2	4.0	0.96	20	0.01	5.0
77-009	Bluegill Sunfish	I	P	C	S	9	18.0	4.33	300	0.17	16.6
77-010	Orangespotted Sunfish	I		C	S	3	6.0	1.44	20	0.01	3.3
77-011	Longear Sunfish	I	M	C	S	3	6.0	1.44	120	0.07	20.0
80-016	Banded Darter	I	I	S	D	1	2.0	0.48	2	0.00	1.0
80-022	Rainbow Darter	I	M	S	D	1	2.0	0.48	2	0.00	1.0
80-026	Sauger X Walleye	P			E	5	10.0	2.40	8600	4.84	860.0
85-001	Freshwater Drum		P	M		2	4.0	0.96	7800	4.39	1950.0
90-002	Mottled Sculpin	I		C		3	6.0	1.44	6	0.00	1.0

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

No Species: 37	Nat. Species: 37	Hybrids: 2	Total Counted: 208	Total Rel. Wt. : 177828
IBI: 52.0	MIwb: 10.5			

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SRCSMZ River: 02-001 Scioto River RM: 118.10 Date: 08/08/2022

Time Fished: 617 Distance: 0.500 Drainge (sq mi): 1710.0 Depth: 0

Location: Southerly WWTP mixing zone Lat: 39.81171 Long: -83.01629

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-002	Bigmouth Buffalo	I		M	C	1	2.0	2.86	4600	8.35	2300.0
40-004	Smallmouth Buffalo	I		M	C	3	6.0	8.57	9200	16.69	1533.3
40-006	River Carpsucker	O		M	C	14	28.0	40.00	21600	39.19	771.4
40-008	Silver Redhorse	I	M	S	R	1	2.0	2.86	5300	9.62	2650.0
43-001	Common Carp	O	T	M	G	2	4.0	5.71	10600	19.23	2650.0
43-032	Spotfin Shiner	I		M	N	1	2.0	2.86	4	0.01	2.0
47-002	Channel Catfish			C	F	1	2.0	2.86	3500	6.35	1750.0
77-006	Largemouth Bass	C		C	F	3	6.0	8.57	20	0.04	3.3
77-008	Green Sunfish	I	T	C	S	3	6.0	8.57	116	0.21	19.3
77-009	Bluegill Sunfish	I	P	C	S	4	8.0	11.43	40	0.07	5.0
77-011	Longear Sunfish	I	M	C	S	2	4.0	5.71	140	0.25	35.0

No Species: 11 **Nat. Species:** 10 **Hybrids:** 0 **Total Counted:** 35 **Total Rel. Wt. :** 55120

IBI: 30.0 **MIwb:** 7.6

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SRCSMZ River: 02-001 Scioto River RM: 118.10 Date: 09/13/2022

Time Fished: 591 Distance: 0.500 Drainge (sq mi): 1710.0 Depth: 0

Location: Southerly WWTP mixing zone Lat: 39.81171 Long: -83.01629

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-004	Smallmouth Buffalo	I		M	C	2	4.0	5.00	6400	15.07	1600.0
40-005	Quillback Carpsucker	O		M	C	1	2.0	2.50	1400	3.30	700.0
40-006	River Carpsucker	O		M	C	12	24.0	30.00	19900	46.85	829.1
40-008	Silver Redhorse	I	M	S	R	1	2.0	2.50	2900	6.83	1450.0
43-001	Common Carp	O	T	M	G	1	2.0	2.50	5100	12.01	2550.0
43-020	Emerald Shiner	I		M	N	2	4.0	5.00	4	0.01	1.0
43-032	Spotfin Shiner	I		M	N	2	4.0	5.00	6	0.01	1.5
43-043	Bluntnose Minnow	O	T	C	N	7	14.0	17.50	30	0.07	2.1
47-002	Channel Catfish			C	F	2	4.0	5.00	4000	9.42	1000.0
77-005	Spotted Bass	C		C	F	1	2.0	2.50	800	1.88	400.0
77-006	Largemouth Bass	C		C	F	1	2.0	2.50	20	0.05	10.0
77-008	Green Sunfish	I	T	C	S	2	4.0	5.00	40	0.09	10.0
77-009	Bluegill Sunfish	I	P	C	S	2	4.0	5.00	100	0.24	25.0
77-015	Green X Bluegill Sunfish					1	2.0	2.50	70	0.16	35.0
80-001	Sauger	P		S	F	1	2.0	2.50	1000	2.35	500.0
80-004	Ducky Darter	I	M	S	D	1	2.0	2.50	10	0.02	5.0
80-026	Sauger X Walleye	P			E	1	2.0	2.50	700	1.65	350.0

No Species: 15 **Nat. Species:** 14 **Hybrids:** 2 **Total Counted:** 40 **Total Rel. Wt. :** 42480

IBI: 26.0 **MIwb:** 7.6

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR12 River: 02-001 Scioto River RM: 118.00 Date: 08/08/2022
 Time Fished: 2281 Distance: 0.500 Drainge (sq mi): 1710.0 Depth: 0
 Location: dst. Southerly WWTP Lat: 39.80933 Long: -83.01583

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		17	34.0	11.64	70	0.05	2.0
40-004	Smallmouth Buffalo	I		M	C	3	6.0	2.05	10300	8.05	1716.6
40-005	Quillback Carpsucker	O		M	C	10	20.0	6.85	16000	12.51	800.0
40-006	River Carpsucker	O		M	C	9	18.0	6.16	13000	10.16	722.2
40-010	Golden Redhorse	I	M	S	R	15	30.0	10.27	20200	15.79	673.3
40-015	Northern Hog Sucker	I	M	S	R	5	10.0	3.42	1500	1.17	150.0
40-023	Smallmouth Redhorse	I	M	S	R	14	28.0	9.59	18200	14.23	650.0
43-001	Common Carp	O	T	M	G	1	2.0	0.68	5800	4.53	2900.0
43-003	Golden Shiner	I	T	M	N	1	2.0	0.68	4	0.00	2.0
43-007	Bigeye Chub	I	I	S	N	9	18.0	6.16	60	0.05	3.3
43-008	Streamline Chub	I	R	S	N	3	6.0	2.05	60	0.05	10.0
43-021	Silver Shiner	I	I	S	N	1	2.0	0.68	4	0.00	2.0
43-022	Rosyface Shiner	I	I	S	N	2	4.0	1.37	4	0.00	1.0
43-032	Spotfin Shiner	I		M	N	14	28.0	9.59	60	0.05	2.1
43-034	Sand Shiner	I	I	M	N	6	12.0	4.11	20	0.02	1.6
43-044	Central Stoneroller	H		N	N	2	4.0	1.37	16	0.01	4.0
47-002	Channel Catfish			C	F	2	4.0	1.37	9300	7.27	2325.0
47-007	Flathead Catfish	P		C	F	1	2.0	0.68	20000	15.63	10000.0
77-004	Smallmouth Bass	C	M	C	F	1	2.0	0.68	10	0.01	5.0
77-005	Spotted Bass	C		C	F	4	8.0	2.74	600	0.47	75.0
77-006	Largemouth Bass	C		C	F	1	2.0	0.68	6	0.00	3.0
77-008	Green Sunfish	I	T	C	S	2	4.0	1.37	46	0.04	11.5
77-009	Bluegill Sunfish	I	P	C	S	3	6.0	2.05	86	0.07	14.3
77-011	Longear Sunfish	I	M	C	S	7	14.0	4.79	200	0.16	14.2
80-011	Logperch	I	M	S	D	7	14.0	4.79	240	0.19	17.1
80-015	Greenside Darter	I	M	S	D	1	2.0	0.68	4	0.00	2.0
80-026	Sauger X Walleye	P			E	2	4.0	1.37	2750	2.15	687.5
85-001	Freshwater Drum		P	M		3	6.0	2.05	9400	7.35	1566.6

No Species: 26 **Nat. Species:** 26 **Hybrids:** 1 **Total Counted:** 146 **Total Rel. Wt. :** 127940

IBI: 48.0 **MIwb:** 10.2

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR12 River: 02-001 Scioto River RM: 118.00 Date: 09/13/2022
 Time Fished: 2337 Distance: 0.500 Drainge (sq mi): 1710.0 Depth: 0
 Location: dst. Southerly WWTP Lat: 39.80933 Long: -83.01583

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		5	10.0	3.13	1400	0.84	140.0
40-003	Black Buffalo	I		M	C	2	4.0	1.25	11000	6.61	2750.0
40-004	Smallmouth Buffalo	I		M	C	12	24.0	7.50	37100	22.30	1545.8
40-005	Quillback Carpsucker	O		M	C	3	6.0	1.88	4400	2.64	733.3
40-006	River Carpsucker	O		M	C	25	50.0	15.63	39200	23.56	784.0
40-009	Black Redhorse	I	I	S	R	1	2.0	0.63	1600	0.96	800.0
40-010	Golden Redhorse	I	M	S	R	6	12.0	3.75	7700	4.63	641.6
40-015	Northern Hog Sucker	I	M	S	R	3	6.0	1.88	3600	2.16	600.0
40-023	Smallmouth Redhorse	I	M	S	R	21	42.0	13.13	27100	16.29	645.2
43-001	Common Carp	O	T	M	G	1	2.0	0.63	4800	2.89	2400.0
43-007	Bigeye Chub	I	I	S	N	2	4.0	1.25	6	0.00	1.5
43-008	Streamline Chub	I	R	S	N	4	8.0	2.50	40	0.02	5.0
43-020	Emerald Shiner	I		M	N	15	30.0	9.38	80	0.05	2.6
43-021	Silver Shiner	I	I	S	N	13	26.0	8.13	130	0.08	5.0
43-022	Rosyface Shiner	I	I	S	N	1	2.0	0.63	2	0.00	1.0
43-025	Striped Shiner	I		S	N	2	4.0	1.25	6	0.00	1.5
43-032	Spotfin Shiner	I		M	N	12	24.0	7.50	80	0.05	3.3
43-034	Sand Shiner	I	I	M	N	1	2.0	0.63	2	0.00	1.0
43-043	Bluntnose Minnow	O	T	C	N	1	2.0	0.63	6	0.00	3.0
43-044	Central Stoneroller	H		N	N	1	2.0	0.63	10	0.01	5.0
47-002	Channel Catfish			C	F	6	12.0	3.75	18100	10.88	1508.3
47-007	Flathead Catfish	P		C	F	1	2.0	0.63	400	0.24	200.0
77-004	Smallmouth Bass	C	M	C	F	3	6.0	1.88	240	0.14	40.0
77-005	Spotted Bass	C		C	F	6	12.0	3.75	920	0.55	76.6
77-009	Bluegill Sunfish	I	P	C	S	4	8.0	2.50	120	0.07	15.0
77-011	Longear Sunfish	I	M	C	S	4	8.0	2.50	180	0.11	22.5
80-011	Logperch	I	M	S	D	1	2.0	0.63	30	0.02	15.0
80-026	Sauger X Walleye	P			E	2	4.0	1.25	4800	2.89	1200.0
85-001	Freshwater Drum		P	M		1	2.0	0.63	3300	1.98	1650.0
90-002	Mottled Sculpin	I		C		1	2.0	0.63	10	0.01	5.0

No Species: 28 **Nat. Species:** 28 **Hybrids:** 1 **Total Counted:** 160 **Total Rel. Wt. :** 166362
IBI: 46.0 **MIwb:** 10.2

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR13 River: 02-001 Scioto River RM: 117.15 Date: 08/08/2022
 Time Fished: 3105 Distance: 0.500 Drainge (sq mi): 2260.0 Depth: 0
 Location: dst. Big Walnut Creek Lat: 39.79924 Long: -83.01015

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		2	4.0	1.33	1700	1.23	425.0
20-003	Gizzard Shad	O		M		13	26.0	8.67	1600	1.16	61.5
40-003	Black Buffalo	I		M	C	1	2.0	0.67	4800	3.48	2400.0
40-004	Smallmouth Buffalo	I		M	C	6	12.0	4.00	18000	13.04	1500.0
40-006	River Carpsucker	O		M	C	7	14.0	4.67	10000	7.25	714.2
40-008	Silver Redhorse	I	M	S	R	1	2.0	0.67	2200	1.59	1100.0
40-010	Golden Redhorse	I	M	S	R	16	32.0	10.67	22700	16.45	709.3
40-015	Northern Hog Sucker	I	M	S	R	4	8.0	2.67	600	0.43	75.0
40-023	Smallmouth Redhorse	I	M	S	R	13	26.0	8.67	16000	11.59	615.3
43-001	Common Carp	O	T	M	G	4	8.0	2.67	30600	22.17	3825.0
43-007	Bigeye Chub	I	I	S	N	5	10.0	3.33	20	0.01	2.0
43-008	Streamline Chub	I	R	S	N	8	16.0	5.33	140	0.10	8.7
43-009	Gravel Chub	I	M	S	N	3	6.0	2.00	40	0.03	6.6
43-015	Suckermouth Minnow	I		S	N	1	2.0	0.67	4	0.00	2.0
43-020	Emerald Shiner	I		M	N	5	10.0	3.33	30	0.02	3.0
43-021	Silver Shiner	I	I	S	N	1	2.0	0.67	4	0.00	2.0
43-032	Spotfin Shiner	I		M	N	17	34.0	11.33	110	0.08	3.2
43-034	Sand Shiner	I	M	M	N	2	4.0	1.33	6	0.00	1.5
43-035	Mimic Shiner	I	I	M	N	1	2.0	0.67	2	0.00	1.0
43-043	Bluntnose Minnow	O	T	C	N	1	2.0	0.67	2	0.00	1.0
47-002	Channel Catfish			C	F	4	8.0	2.67	13500	9.78	1687.5
74-001	White Bass	P		M	F	2	4.0	1.33	470	0.34	117.5
77-004	Smallmouth Bass	C	M	C	F	4	8.0	2.67	1360	0.99	170.0
77-005	Spotted Bass	C		C	F	2	4.0	1.33	200	0.14	50.0
77-006	Largemouth Bass	C		C	F	2	4.0	1.33	40	0.03	10.0
77-009	Bluegill Sunfish	I	P	C	S	4	8.0	2.67	120	0.09	15.0
77-011	Longear Sunfish	I	M	C	S	2	4.0	1.33	100	0.07	25.0
80-004	Ducky Darter	I	M	S	D	1	2.0	0.67	2	0.00	1.0
80-011	Logperch	I	M	S	D	3	6.0	2.00	20	0.01	3.3
80-014	Johnny Darter	I		C	D	3	6.0	2.00	6	0.00	1.0
80-015	Greenside Darter	I	M	S	D	1	2.0	0.67	4	0.00	2.0
80-016	Banded Darter	I	I	S	D	1	2.0	0.67	4	0.00	2.0
80-017	Variagate Darter	I	I	S	D	1	2.0	0.67	14	0.01	7.0
80-022	Rainbow Darter	I	M	S	D	1	2.0	0.67	2	0.00	1.0
80-026	Sauger X Walleye	P			E	3	6.0	2.00	5300	3.84	883.3
85-001	Freshwater Drum		P	M		4	8.0	2.67	8300	6.01	1037.5
90-002	Mottled Sculpin	I		C		1	2.0	0.67	2	0.00	1.0

No Species: 35 **Nat. Species:** 35 **Hybrids:** 1 **Total Counted:** 150 **Total Rel. Wt. :** 138002
IBI: 54.0 **MIwb:** 10.3

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR13 River: 02-001 Scioto River RM: 117.15 Date: 09/13/2022
 Time Fished: 2412 Distance: 0.500 Drainge (sq mi): 2260.0 Depth: 0
 Location: dst. Big Walnut Creek Lat: 39.79924 Long: -83.01015

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		4	8.0	3.17	5900	2.64	737.5
18-002	Mooneye	I	R	M		2	4.0	1.59	1140	0.51	285.0
20-003	Gizzard Shad	O		M		3	6.0	2.38	640	0.29	106.6
40-003	Black Buffalo	I		M	C	4	8.0	3.17	22500	10.07	2812.5
40-004	Smallmouth Buffalo	I		M	C	15	30.0	11.90	53400	23.89	1780.0
40-005	Quillback Carpsucker	O		M	C	2	4.0	1.59	3100	1.39	775.0
40-006	River Carpsucker	O		M	C	9	18.0	7.14	13400	5.99	744.4
40-010	Golden Redhorse	I	M	S	R	13	26.0	10.32	18600	8.32	715.3
40-013	River Redhorse	I	I	S	R	1	2.0	0.79	6000	2.68	3000.0
40-015	Northern Hog Sucker	I	M	S	R	4	8.0	3.17	430	0.19	53.7
43-001	Common Carp	O	T	M	G	1	2.0	0.79	7800	3.49	3900.0
43-008	Streamline Chub	I	R	S	N	5	10.0	3.97	40	0.02	4.0
43-009	Gravel Chub	I	M	S	N	3	6.0	2.38	16	0.01	2.6
43-015	Suckermouth Minnow	I		S	N	8	16.0	6.35	40	0.02	2.5
43-020	Emerald Shiner	I		M	N	10	20.0	7.94	60	0.03	3.0
43-021	Silver Shiner	I	I	S	N	1	2.0	0.79	6	0.00	3.0
43-023	Redfin Shiner	I		N	N	7	14.0	5.56	9000	4.03	642.8
43-031	Steelcolor Shiner	I	P	M	N	1	2.0	0.79	10	0.00	5.0
43-034	Sand Shiner	I	I	M	N	2	4.0	1.59	6	0.00	1.5
43-043	Bluntnose Minnow	O	T	C	N	1	2.0	0.79	4	0.00	2.0
43-044	Central Stoneroller	H		N	N	2	4.0	1.59	16	0.01	4.0
43-047	Grass Carp			M	E	2	4.0	1.59	35000	15.66	8750.0
47-002	Channel Catfish			C	F	3	6.0	2.38	10900	4.88	1816.6
77-002	Black Crappie	I		C	S	1	2.0	0.79	1000	0.45	500.0
77-004	Smallmouth Bass	C	M	C	F	1	2.0	0.79	2300	1.03	1150.0
77-005	Spotted Bass	C		C	F	1	2.0	0.79	100	0.04	50.0
77-009	Bluegill Sunfish	I	P	C	S	3	6.0	2.38	240	0.11	40.0
77-011	Longear Sunfish	I	M	C	S	4	8.0	3.17	160	0.07	20.0
80-001	Sauger	P		S	F	1	2.0	0.79	1000	0.45	500.0
80-004	Ducky Darter	I	M	S	D	2	4.0	1.59	16	0.01	4.0
80-026	Sauger X Walleye	P			E	1	2.0	0.79	1100	0.49	550.0
85-001	Freshwater Drum		P	M		9	18.0	7.14	29600	13.24	1644.4

No Species: 30 **Nat. Species:** 29 **Hybrids:** 1 **Total Counted:** 126 **Total Rel. Wt. :** 223524
IBI: 46.0 **MIwb:** 10.7

Appendix Table B-4. Midwest Biodiversity Institute

Fish Species List

Site ID: SR14 River: 02-001 Scioto River RM: 116.00 Date: 08/08/2022

Time Fished: 2411 Distance: 0.500 Drainge (sq mi): 2270.0 Depth: 0

Location: dst. historic Pickaway Power Plant lot Lat: 39.78415 Long: -83.00990

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		15	30.0	7.28	1340	0.75	44.6
40-003	Black Buffalo	I		M	C	6	12.0	2.91	28300	15.78	2358.3
40-004	Smallmouth Buffalo	I		M	C	9	18.0	4.37	30600	17.06	1700.0
40-005	Quillback Carpsucker	O		M	C	4	8.0	1.94	6700	3.74	837.5
40-006	River Carpsucker	O		M	C	5	10.0	2.43	7300	4.07	730.0
40-008	Silver Redhorse	I	M	S	R	1	2.0	0.49	4800	2.68	2400.0
40-009	Black Redhorse	I	I	S	R	1	2.0	0.49	1300	0.72	650.0
40-010	Golden Redhorse	I	M	S	R	11	22.0	5.34	14400	8.03	654.5
40-015	Northern Hog Sucker	I	M	S	R	12	24.0	5.83	5910	3.30	246.2
40-023	Smallmouth Redhorse	I	M	S	R	22	44.0	10.68	29100	16.23	661.3
43-001	Common Carp	O	T	M	G	1	2.0	0.49	4100	2.29	2050.0
43-007	Bigeye Chub	I	I	S	N	3	6.0	1.46	32	0.02	5.3
43-008	Streamline Chub	I	R	S	N	2	4.0	0.97	40	0.02	10.0
43-009	Gravel Chub	I	M	S	N	20	40.0	9.71	220	0.12	5.5
43-015	Suckermouth Minnow	I		S	N	3	6.0	1.46	18	0.01	3.0
43-020	Emerald Shiner	I		M	N	6	12.0	2.91	30	0.02	2.5
43-021	Silver Shiner	I	I	S	N	1	2.0	0.49	4	0.00	2.0
43-031	Steelcolor Shiner	I	P	M	N	1	2.0	0.49	8	0.00	4.0
43-032	Spotfin Shiner	I		M	N	23	46.0	11.17	160	0.09	3.4
43-034	Sand Shiner	I	I	M	N	5	10.0	2.43	16	0.01	1.6
43-035	Mimic Shiner	I	I	M	N	4	8.0	1.94	12	0.01	1.5
43-044	Central Stoneroller	H		N	N	9	18.0	4.37	40	0.02	2.2
47-002	Channel Catfish			C	F	12	24.0	5.83	24900	13.89	1037.5
77-004	Smallmouth Bass	C	M	C	F	4	8.0	1.94	1300	0.72	162.5
77-005	Spotted Bass	C		C	F	1	2.0	0.49	40	0.02	20.0
77-008	Green Sunfish	I	T	C	S	1	2.0	0.49	2	0.00	1.0
77-009	Bluegill Sunfish	I	P	C	S	1	2.0	0.49	50	0.03	25.0
80-001	Sauger	P		S	F	1	2.0	0.49	500	0.28	250.0
80-007	Slenderhead Darter	I	R	S	D	1	2.0	0.49	4	0.00	2.0
80-015	Greenside Darter	I	M	S	D	1	2.0	0.49	4	0.00	2.0
80-016	Banded Darter	I	I	S	D	8	16.0	3.88	20	0.01	1.2
80-017	Variagate Darter	I	I	S	D	2	4.0	0.97	10	0.01	2.5
80-022	Rainbow Darter	I	M	S	D	2	4.0	0.97	6	0.00	1.5
80-026	Sauger X Walleye	P			E	1	2.0	0.49	950	0.53	475.0
85-001	Freshwater Drum		P	M		7	14.0	3.40	17100	9.54	1221.4

No Species: 33 **Nat. Species:** 33 **Hybrids:** 1 **Total Counted:** 206 **Total Rel. Wt. :** 179316

IBI: 50.0 **MIwb:** 10.8

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR14 River: 02-001 Scioto River RM: 116.00 Date: 09/13/2022
 Time Fished: 2453 Distance: 0.500 Drainge (sq mi): 2270.0 Depth: 0
 Location: dst. historic Pickaway Power Plant lot Lat: 39.78415 Long: -83.00990

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		2	4.0	0.61	6250	3.55	1562.5
20-003	Gizzard Shad	O		M		7	14.0	2.14	1020	0.58	72.8
40-003	Black Buffalo	I		M	C	1	2.0	0.31	5400	3.06	2700.0
40-004	Smallmouth Buffalo	I		M	C	21	42.0	6.42	77600	44.04	1847.6
40-005	Quillback Carpsucker	O		M	C	6	12.0	1.83	10400	5.90	866.6
40-006	River Carpsucker	O		M	C	9	18.0	2.75	12200	6.92	677.7
40-008	Silver Redhorse	I	M	S	R	1	2.0	0.31	2800	1.59	1400.0
40-010	Golden Redhorse	I	M	S	R	12	24.0	3.67	14700	8.34	612.5
40-015	Northern Hog Sucker	I	M	S	R	17	34.0	5.20	12940	7.34	380.5
40-023	Smallmouth Redhorse	I	M	S	R	15	30.0	4.59	18600	10.56	620.0
43-005	River Chub	I	I	N	N	1	2.0	0.31	8	0.00	4.0
43-007	Bigeye Chub	I	I	S	N	22	44.0	6.73	60	0.03	1.3
43-008	Streamline Chub	I	R	S	N	8	16.0	2.45	150	0.09	9.3
43-009	Gravel Chub	I	M	S	N	13	26.0	3.98	120	0.07	4.6
43-015	Suckermouth Minnow	I		S	N	29	58.0	8.87	200	0.11	3.4
43-020	Emerald Shiner	I		M	N	65	130.0	19.88	220	0.12	1.6
43-021	Silver Shiner	I	I	S	N	2	4.0	0.61	12	0.01	3.0
43-022	Rosyface Shiner	I	I	S	N	1	2.0	0.31	2	0.00	1.0
43-025	Striped Shiner	I		S	N	2	4.0	0.61	6	0.00	1.5
43-031	Steelcolor Shiner	I	P	M	N	3	6.0	0.92	50	0.03	8.3
43-032	Spotfin Shiner	I		M	N	4	8.0	1.22	16	0.01	2.0
43-034	Sand Shiner	I	I	M	N	22	44.0	6.73	60	0.03	1.3
43-035	Mimic Shiner	I	I	M	N	8	16.0	2.45	10	0.01	0.6
43-043	Bluntnose Minnow	O	T	C	N	2	4.0	0.61	10	0.01	2.5
43-044	Central Stoneroller	H		N	N	31	62.0	9.48	380	0.22	6.1
47-002	Channel Catfish			C	F	2	4.0	0.61	4600	2.61	1150.0
74-005	Striped Bass X White Bass				E	1	2.0	0.31	2000	1.14	1000.0
77-005	Spotted Bass	C		C	F	4	8.0	1.22	800	0.45	100.0
77-009	Bluegill Sunfish	I	P	C	S	1	2.0	0.31	70	0.04	35.0
80-011	Logperch	I	M	S	D	1	2.0	0.31	60	0.03	30.0
80-015	Greenside Darter	I	M	S	D	2	4.0	0.61	16	0.01	4.0
80-016	Banded Darter	I	I	S	D	2	4.0	0.61	6	0.00	1.5
80-017	Variagate Darter	I	I	S	D	4	8.0	1.22	40	0.02	5.0
80-020	Tippecanoe Darter	I	R	S	D	1	2.0	0.31	2	0.00	1.0
80-026	Sauger X Walleye	P			E	3	6.0	0.92	3200	1.82	533.3
85-001	Freshwater Drum		P	M		2	4.0	0.61	2200	1.25	550.0

No Species: 33 **Nat. Species:** 34 **Hybrids:** 2 **Total Counted:** 327 **Total Rel. Wt. :** 176208
IBI: 48.0 **MIwb:** 10.5

Appendix Table B-4. Midwest Biodiversity Institute

Fish Species List

Site ID: SR15 River: 02-001 Scioto River RM: 114.00 Date: 08/10/2022

Time Fished: 3021 Distance: 0.500 Drainge (sq mi): 2280.0 Depth: 0

Location: dst. SR. 762 Lat: 39.75948 Long: -82.99931

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
18-002	Mooneye	I	R	M		1	2.0	0.58	260	0.20	130.0
20-003	Gizzard Shad	O		M		4	8.0	2.33	1700	1.32	212.5
40-003	Black Buffalo	I		M	C	2	4.0	1.16	11700	9.11	2925.0
40-004	Smallmouth Buffalo	I		M	C	4	8.0	2.33	14400	11.22	1800.0
40-006	River Carpsucker	O		M	C	6	12.0	3.49	8400	6.54	700.0
40-008	Silver Redhorse	I	M	S	R	1	2.0	0.58	5800	4.52	2900.0
40-010	Golden Redhorse	I	M	S	R	2	4.0	1.16	2000	1.56	500.0
40-015	Northern Hog Sucker	I	M	S	R	7	14.0	4.07	1740	1.36	124.2
40-023	Smallmouth Redhorse	I	M	S	R	32	64.0	18.60	44600	34.74	696.8
43-001	Common Carp	O	T	M	G	3	6.0	1.74	14400	11.22	2400.0
43-007	Bigeye Chub	I	I	S	N	4	8.0	2.33	24	0.02	3.0
43-008	Streamline Chub	I	R	S	N	5	10.0	2.91	80	0.06	8.0
43-009	Gravel Chub	I	M	S	N	1	2.0	0.58	10	0.01	5.0
43-015	Suckermouth Minnow	I		S	N	1	2.0	0.58	8	0.01	4.0
43-020	Emerald Shiner	I		M	N	20	40.0	11.63	100	0.08	2.5
43-021	Silver Shiner	I	I	S	N	1	2.0	0.58	4	0.00	2.0
43-025	Striped Shiner	I		S	N	2	4.0	1.16	4	0.00	1.0
43-032	Spotfin Shiner	I		M	N	4	8.0	2.33	20	0.02	2.5
43-034	Sand Shiner	I	I	M	N	1	2.0	0.58	4	0.00	2.0
43-043	Bluntnose Minnow	O	T	C	N	6	12.0	3.49	22	0.02	1.8
43-044	Central Stoneroller	H		N	N	12	24.0	6.98	60	0.05	2.5
47-002	Channel Catfish			C	F	7	14.0	4.07	10202	7.95	728.7
77-005	Spotted Bass	C		C	F	2	4.0	1.16	160	0.12	40.0
77-006	Largemouth Bass	C		C	F	1	2.0	0.58	10	0.01	5.0
77-008	Green Sunfish	I	T	C	S	2	4.0	1.16	40	0.03	10.0
77-009	Bluegill Sunfish	I	P	C	S	3	6.0	1.74	90	0.07	15.0
77-011	Longear Sunfish	I	M	C	S	2	4.0	1.16	50	0.04	12.5
80-011	Logperch	I	M	S	D	1	2.0	0.58	6	0.00	3.0
80-014	Johnny Darter	I		C	D	1	2.0	0.58	2	0.00	1.0
80-015	Greenside Darter	I	M	S	D	6	12.0	3.49	20	0.02	1.6
80-016	Banded Darter	I	I	S	D	7	14.0	4.07	20	0.02	1.4
80-017	Variagate Darter	I	I	S	D	2	4.0	1.16	12	0.01	3.0
80-019	Bluebreast Darter	I	R	S	D	1	2.0	0.58	4	0.00	2.0
80-020	Tippecanoe Darter	I	R	S	D	6	12.0	3.49	6	0.00	0.5
80-022	Rainbow Darter	I	M	S	D	3	6.0	1.74	6	0.00	1.0
80-026	Sauger X Walleye	P			E	1	2.0	0.58	2400	1.87	1200.0
85-001	Freshwater Drum		P	M		4	8.0	2.33	10000	7.79	1250.0
90-002	Mottled Sculpin	I		C		4	8.0	2.33	10	0.01	1.2

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

No Species: 36	Nat. Species: 36	Hybrids: 1	Total Counted: 172	Total Rel. Wt. : 128374
IBI: 48.0	MIwb: 10.3			

Appendix Table B-4. Midwest Biodiversity Institute

Fish Species List

Site ID: SR15 River: 02-001 Scioto River RM: 114.00 Date: 09/14/2022

Time Fished: 3104 Distance: 0.500 Drainge (sq mi): 2280.0 Depth: 0

Location: dst. SR. 762 Lat: 39.75948 Long: -82.99931

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
18-002	Mooneye	I	R	M		1	2.0	0.29	600	0.42	300.0
20-001	Skipjack Herring	P		M		1	2.0	0.29	90	0.06	45.0
20-003	Gizzard Shad	O		M		14	28.0	4.01	1560	1.10	55.7
40-004	Smallmouth Buffalo	I		M	C	16	32.0	4.58	60800	42.88	1900.0
40-006	River Carpsucker	O		M	C	3	6.0	0.86	4600	3.24	766.6
40-010	Golden Redhorse	I	M	S	R	3	6.0	0.86	4500	3.17	750.0
40-015	Northern Hog Sucker	I	M	S	R	24	48.0	6.88	9380	6.61	195.4
40-023	Smallmouth Redhorse	I	M	S	R	19	38.0	5.44	31200	22.00	821.0
43-001	Common Carp	O	T	M	G	2	4.0	0.57	10000	7.05	2500.0
43-007	Bigeye Chub	I	I	S	N	4	8.0	1.15	20	0.01	2.5
43-008	Streamline Chub	I	R	S	N	20	40.0	5.73	300	0.21	7.5
43-009	Gravel Chub	I	M	S	N	86	172.0	24.64	820	0.58	4.7
43-015	Suckermouth Minnow	I		S	N	19	38.0	5.44	140	0.10	3.6
43-020	Emerald Shiner	I		M	N	40	80.0	11.46	250	0.18	3.1
43-021	Silver Shiner	I	I	S	N	3	6.0	0.86	24	0.02	4.0
43-022	Rosyface Shiner	I	I	S	N	1	2.0	0.29	2	0.00	1.0
43-025	Striped Shiner	I		S	N	5	10.0	1.43	20	0.01	2.0
43-031	Steelcolor Shiner	I	P	M	N	6	12.0	1.72	60	0.04	5.0
43-032	Spotfin Shiner	I		M	N	8	16.0	2.29	40	0.03	2.5
43-041	Bullhead Minnow	O		C	N	1	2.0	0.29	6	0.00	3.0
43-044	Central Stoneroller	H		N	N	14	28.0	4.01	100	0.07	3.5
47-002	Channel Catfish			C	F	3	6.0	0.86	6200	4.37	1033.3
77-004	Smallmouth Bass	C	M	C	F	8	16.0	2.29	2840	2.00	177.5
77-005	Spotted Bass	C		C	F	2	4.0	0.57	360	0.25	90.0
77-006	Largemouth Bass	C		C	F	2	4.0	0.57	80	0.06	20.0
77-009	Bluegill Sunfish	I	P	C	S	7	14.0	2.01	160	0.11	11.4
77-010	Orangespotted Sunfish	I		C	S	1	2.0	0.29	10	0.01	5.0
77-011	Longear Sunfish	I	M	C	S	1	2.0	0.29	20	0.01	10.0
80-001	Sauger	P		S	F	3	6.0	0.86	1800	1.27	300.0
80-007	Slenderhead Darter	I	R	S	D	1	2.0	0.29	4	0.00	2.0
80-011	Loggerhead	I	M	S	D	4	8.0	1.15	50	0.04	6.2
80-015	Greenside Darter	I	M	S	D	4	8.0	1.15	20	0.01	2.5
80-016	Banded Darter	I	I	S	D	7	14.0	2.01	10	0.01	0.7
80-017	Variagate Darter	I	I	S	D	2	4.0	0.57	10	0.01	2.5
80-019	Bluebreast Darter	I	R	S	D	4	8.0	1.15	8	0.01	1.0
80-020	Tippecanoe Darter	I	R	S	D	4	8.0	1.15	8	0.01	1.0
80-022	Rainbow Darter	I	M	S	D	3	6.0	0.86	6	0.00	1.0
85-001	Freshwater Drum		P	M		2	4.0	0.57	5700	4.02	1425.0
90-002	Mottled Sculpin	I		C		1	2.0	0.29	4	0.00	2.0

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

No Species: 38	Nat. Species: 38	Hybrids: 0	Total Counted: 349	Total Rel. Wt. : 141802
IBI: 48.0	MIwb: 10.4			

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR16 River: 02-001 Scioto River RM: 109.35 Date: 08/10/2022
 Time Fished: 2447 Distance: 0.500 Drainge (sq mi): 2310.0 Depth: 0
 Location: dst. OH-316 Lat: 39.71945 Long: -83.01266

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		4	8.0	1.83	4000	2.77	500.0
40-003	Black Buffalo	I		M	C	4	8.0	1.83	18500	12.79	2312.5
40-004	Smallmouth Buffalo	I		M	C	10	20.0	4.59	38900	26.89	1945.0
40-005	Quillback Carpsucker	O		M	C	1	2.0	0.46	2200	1.52	1100.0
40-006	River Carpsucker	O		M	C	2	4.0	0.92	3200	2.21	800.0
40-008	Silver Redhorse	I	M	S	R	2	4.0	0.92	11800	8.16	2950.0
40-010	Golden Redhorse	I	M	S	R	4	8.0	1.83	4900	3.39	612.5
40-013	River Redhorse	I	I	S	R	2	4.0	0.92	13600	9.40	3400.0
40-015	Northern Hog Sucker	I	M	S	R	8	16.0	3.67	2216	1.53	138.5
40-023	Smallmouth Redhorse	I	M	S	R	16	32.0	7.34	19600	13.55	612.5
43-001	Common Carp	O	T	M	G	1	2.0	0.46	350	0.24	175.0
43-007	Bigeye Chub	I	I	S	N	18	36.0	8.26	90	0.06	2.5
43-008	Streamline Chub	I	R	S	N	1	2.0	0.46	2	0.00	1.0
43-009	Gravel Chub	I	M	S	N	25	50.0	11.47	220	0.15	4.4
43-015	Suckermouth Minnow	I		S	N	1	2.0	0.46	4	0.00	2.0
43-020	Emerald Shiner	I		M	N	39	78.0	17.89	140	0.10	1.7
43-021	Silver Shiner	I	I	S	N	6	12.0	2.75	40	0.03	3.3
43-025	Striped Shiner	I		S	N	4	8.0	1.83	10	0.01	1.2
43-031	Steelcolor Shiner	I	P	M	N	5	10.0	2.29	100	0.07	10.0
43-032	Spotfin Shiner	I		M	N	10	20.0	4.59	100	0.07	5.0
43-034	Sand Shiner	I	I	M	N	10	20.0	4.59	40	0.03	2.0
43-035	Mimic Shiner	I	I	M	N	1	2.0	0.46	2	0.00	1.0
43-043	Bluntnose Minnow	O	T	C	N	2	4.0	0.92	10	0.01	2.5
43-044	Central Stoneroller	H		N	N	5	10.0	2.29	50	0.03	5.0
47-002	Channel Catfish			C	F	4	8.0	1.83	9200	6.36	1150.0
47-007	Flathead Catfish	P		C	F	1	2.0	0.46	7200	4.98	3600.0
77-002	Black Crappie	I		C	S	2	4.0	0.92	780	0.54	195.0
77-004	Smallmouth Bass	C	M	C	F	2	4.0	0.92	240	0.17	60.0
77-005	Spotted Bass	C		C	F	10	20.0	4.59	1090	0.75	54.5
77-009	Bluegill Sunfish	I	P	C	S	1	2.0	0.46	40	0.03	20.0
77-011	Longear Sunfish	I	M	C	S	3	6.0	1.38	90	0.06	15.0
80-001	Sauger	P		S	F	1	2.0	0.46	300	0.21	150.0
80-011	Logperch	I	M	S	D	2	4.0	0.92	16	0.01	4.0
80-016	Banded Darter	I	I	S	D	4	8.0	1.83	10	0.01	1.2
80-017	Variegated Darter	I	I	S	D	3	6.0	1.38	12	0.01	2.0
80-020	Tippecanoe Darter	I	R	S	D	1	2.0	0.46	2	0.00	1.0
80-022	Rainbow Darter	I	M	S	D	1	2.0	0.46	2	0.00	1.0
85-001	Freshwater Drum		P	M		2	4.0	0.92	5600	3.87	1400.0

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

No Species: 38 **Nat. Species:** 37 **Hybrids:** 0 **Total Counted:** 218 **Total Rel. Wt. :** 144656
IBI: 52.0 **MIwb:** 10.9

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR16 River: 02-001 Scioto River RM: 109.35 Date: 09/14/2022
 Time Fished: 2651 Distance: 0.500 Drainge (sq mi): 2310.0 Depth: 0
 Location: dst. OH-316 Lat: 39.71945 Long: -83.01266

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		6	12.0	1.46	800	0.99	66.6
40-003	Black Buffalo	I		M	C	1	2.0	0.24	6600	8.20	3300.0
40-004	Smallmouth Buffalo	I		M	C	2	4.0	0.49	7200	8.95	1800.0
40-005	Quillback Carpsucker	O		M	C	2	4.0	0.49	3400	4.23	850.0
40-008	Silver Redhorse	I	M	S	R	1	2.0	0.24	4600	5.72	2300.0
40-010	Golden Redhorse	I	M	S	R	1	2.0	0.24	10	0.01	5.0
40-013	River Redhorse	I	I	S	R	1	2.0	0.24	6400	7.96	3200.0
40-015	Northern Hog Sucker	I	M	S	R	27	54.0	6.57	5060	6.29	93.7
40-023	Smallmouth Redhorse	I	M	S	R	22	44.0	5.35	28800	35.80	654.5
43-007	Bigeye Chub	I	I	S	N	5	10.0	1.22	40	0.05	4.0
43-008	Streamline Chub	I	R	S	N	2	4.0	0.49	40	0.05	10.0
43-009	Gravel Chub	I	M	S	N	117	234.0	28.47	600	0.75	2.5
43-015	Suckermouth Minnow	I		S	N	55	110.0	13.38	380	0.47	3.4
43-020	Emerald Shiner	I		M	N	69	138.0	16.79	280	0.35	2.0
43-021	Silver Shiner	I	I	S	N	1	2.0	0.24	6	0.01	3.0
43-022	Rosyface Shiner	I	I	S	N	4	8.0	0.97	8	0.01	1.0
43-031	Steelcolor Shiner	I	P	M	N	11	22.0	2.68	140	0.17	6.3
43-032	Spotfin Shiner	I		M	N	12	24.0	2.92	60	0.07	2.5
43-034	Sand Shiner	I	I	M	N	9	18.0	2.19	30	0.04	1.6
43-035	Mimic Shiner	I	I	M	N	3	6.0	0.73	4	0.00	0.6
43-043	Bluntnose Minnow	O	T	C	N	3	6.0	0.73	6	0.01	1.0
43-044	Central Stoneroller	H		N	N	16	32.0	3.89	140	0.17	4.3
47-002	Channel Catfish			C	F	2	4.0	0.49	7400	9.20	1850.0
70-001	Brook Silverside	I	M	M		1	2.0	0.24	2	0.00	1.0
77-004	Smallmouth Bass	C	M	C	F	6	12.0	1.46	500	0.62	41.6
77-005	Spotted Bass	C		C	F	12	24.0	2.92	1530	1.90	63.7
77-009	Bluegill Sunfish	I	P	C	S	6	12.0	1.46	320	0.40	26.6
80-001	Sauger	P		S	F	1	2.0	0.24	400	0.50	200.0
80-011	Logperch	I	M	S	D	6	12.0	1.46	80	0.10	6.6
80-014	Johnny Darter	I		C	D	1	2.0	0.24	2	0.00	1.0
80-015	Greenside Darter	I	M	S	D	2	4.0	0.49	10	0.01	2.5
80-016	Banded Darter	I	I	S	D	1	2.0	0.24	2	0.00	1.0
80-026	Sauger X Walleye	P			E	1	2.0	0.24	1200	1.49	600.0
85-001	Freshwater Drum		P	M		2	4.0	0.49	4400	5.47	1100.0

No Species: 32 **Nat. Species:** 33 **Hybrids:** 1 **Total Counted:** 411 **Total Rel. Wt. :** 80450

IBI: 48.0 **MIwb:** 10.1

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR17 River: 02-001 Scioto River RM: 107.50 Date: 08/10/2022
 Time Fished: 3001 Distance: 0.500 Drainge (sq mi): 2320.0 Depth: 0
 Location: ust. Walnut Creek Lat: 39.69682 Long: -83.00347

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		1	2.0	0.73	800	0.56	400.0
20-003	Gizzard Shad	O		M		4	8.0	2.92	820	0.57	102.5
40-003	Black Buffalo	I		M	C	3	6.0	2.19	16600	11.55	2766.6
40-004	Smallmouth Buffalo	I		M	C	7	14.0	5.11	18600	12.94	1328.5
40-006	River Carpsucker	O		M	C	5	10.0	3.65	8300	5.77	830.0
40-008	Silver Redhorse	I	M	S	R	1	2.0	0.73	5000	3.48	2500.0
40-010	Golden Redhorse	I	M	S	R	8	16.0	5.84	9800	6.82	612.5
40-015	Northern Hog Sucker	I	M	S	R	3	6.0	2.19	1410	0.98	235.0
40-023	Smallmouth Redhorse	I	M	S	R	16	32.0	11.68	19900	13.84	621.8
43-001	Common Carp	O	T	M	G	3	6.0	2.19	8900	6.19	1483.3
43-007	Bigeye Chub	I	I	S	N	2	4.0	1.46	10	0.01	2.5
43-008	Streamline Chub	I	R	S	N	3	6.0	2.19	40	0.03	6.6
43-009	Gravel Chub	I	M	S	N	10	20.0	7.30	80	0.06	4.0
43-015	Suckermouth Minnow	I		S	N	1	2.0	0.73	4	0.00	2.0
43-020	Emerald Shiner	I		M	N	16	32.0	11.68	90	0.06	2.8
43-031	Steelcolor Shiner	I	P	M	N	1	2.0	0.73	12	0.01	6.0
43-032	Spotfin Shiner	I		M	N	5	10.0	3.65	40	0.03	4.0
43-034	Sand Shiner	I	I	M	N	3	6.0	2.19	12	0.01	2.0
43-043	Bluntnose Minnow	O	T	C	N	1	2.0	0.73	4	0.00	2.0
47-002	Channel Catfish			C	F	2	4.0	1.46	1104	0.77	276.0
47-007	Flathead Catfish	P		C	F	1	2.0	0.73	5100	3.55	2550.0
77-005	Spotted Bass	C		C	F	3	6.0	2.19	304	0.21	50.6
77-009	Bluegill Sunfish	I	P	C	S	2	4.0	1.46	30	0.02	7.5
77-011	Longear Sunfish	I	M	C	S	4	8.0	2.92	220	0.15	27.5
80-001	Sauger	P		S	F	1	2.0	0.73	600	0.42	300.0
80-011	Logperch	I	M	S	D	10	20.0	7.30	80	0.06	4.0
80-015	Greenside Darter	I	M	S	D	1	2.0	0.73	4	0.00	2.0
80-016	Banded Darter	I	I	S	D	2	4.0	1.46	4	0.00	1.0
80-020	Tippecanoe Darter	I	R	S	D	1	2.0	0.73	2	0.00	1.0
80-026	Sauger X Walleye	P			E	3	6.0	2.19	6000	4.17	1000.0
85-001	Freshwater Drum		P	M		13	26.0	9.49	39900	27.75	1534.6
90-002	Mottled Sculpin	I		C		1	2.0	0.73	4	0.00	2.0

No Species: 30 **Nat. Species:** 30 **Hybrids:** 1 **Total Counted:** 137 **Total Rel. Wt. :** 143774
IBI: 50.0 **MIwb:** 10.2

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR17 River: 02-001 Scioto River RM: 107.50 Date: 09/14/2022
 Time Fished: 2605 Distance: 0.500 Drainge (sq mi): 2320.0 Depth: 0
 Location: ust. Walnut Creek Lat: 39.69682 Long: -83.00347

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		1	2.0	0.50	1000	0.56	500.0
20-003	Gizzard Shad	O		M		2	4.0	1.01	900	0.50	225.0
40-004	Smallmouth Buffalo	I		M	C	18	36.0	9.05	64500	36.05	1791.6
40-005	Quillback Carpsucker	O		M	C	3	6.0	1.51	5000	2.79	833.3
40-006	River Carpsucker	O		M	C	10	20.0	5.03	12600	7.04	630.0
40-008	Silver Redhorse	I	M	S	R	3	6.0	1.51	11900	6.65	1983.3
40-010	Golden Redhorse	I	M	S	R	10	20.0	5.03	12000	6.71	600.0
40-015	Northern Hog Sucker	I	M	S	R	7	14.0	3.52	3320	1.86	237.1
40-023	Smallmouth Redhorse	I	M	S	R	20	40.0	10.05	24600	13.75	615.0
43-001	Common Carp	O	T	M	G	3	6.0	1.51	11700	6.54	1950.0
43-007	Bigeye Chub	I	I	S	N	1	2.0	0.50	6	0.00	3.0
43-008	Streamline Chub	I	R	S	N	4	8.0	2.01	60	0.03	7.5
43-009	Gravel Chub	I	M	S	N	21	42.0	10.55	100	0.06	2.3
43-020	Emerald Shiner	I		M	N	49	98.0	24.62	200	0.11	2.0
43-021	Silver Shiner	I	I	S	N	5	10.0	2.51	40	0.02	4.0
43-022	Rosyface Shiner	I	I	S	N	3	6.0	1.51	4	0.00	0.6
43-034	Sand Shiner	I	I	M	N	1	2.0	0.50	4	0.00	2.0
47-002	Channel Catfish			C	F	3	6.0	1.51	5100	2.85	850.0
47-008	Stonecat Madtom	I	I	C		1	2.0	0.50	6	0.00	3.0
47-010	Northern Madtom	I	R	C		1	2.0	0.50	8	0.00	4.0
77-005	Spotted Bass	C		C	F	5	10.0	2.51	620	0.35	62.0
80-001	Sauger	P		S	F	1	2.0	0.50	1000	0.56	500.0
80-011	Logperch	I	M	S	D	4	8.0	2.01	100	0.06	12.5
80-013	Eastern Sand Darter	I	R	S	D	3	6.0	1.51	6	0.00	1.0
80-016	Banded Darter	I	I	S	D	7	14.0	3.52	10	0.01	0.7
80-017	Variagate Darter	I	I	S	D	1	2.0	0.50	10	0.01	5.0
80-019	Bluebreast Darter	I	R	S	D	2	4.0	1.01	4	0.00	1.0
80-020	Tippecanoe Darter	I	R	S	D	1	2.0	0.50	2	0.00	1.0
85-001	Freshwater Drum		P	M		9	18.0	4.52	24100	13.47	1338.8

No Species: 28 **Nat. Species:** 28 **Hybrids:** 0 **Total Counted:** 199 **Total Rel. Wt. :** 178900
IBI: 46.0 **MIwb:** 10.3

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR18 River: 02-001 Scioto River RM: 105.25 Date: 08/10/2022
 Time Fished: 2403 Distance: 0.500 Drainge (sq mi): 2610.0 Depth: 0
 Location: dst. Walnut Creek Lat: 39.67098 Long: -82.99101

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		2	4.0	2.02	1500	1.58	375.0
20-003	Gizzard Shad	O		M		22	44.0	22.22	400	0.42	9.0
40-004	Smallmouth Buffalo	I		M	C	11	22.0	11.11	34400	36.30	1563.6
40-005	Quillback Carpsucker	O		M	C	1	2.0	1.01	1500	1.58	750.0
40-006	River Carpsucker	O		M	C	2	4.0	2.02	3000	3.17	750.0
40-008	Silver Redhorse	I	M	S	R	1	2.0	1.01	4000	4.22	2000.0
40-010	Golden Redhorse	I	M	S	R	1	2.0	1.01	1600	1.69	800.0
40-013	River Redhorse	I	I	S	R	2	4.0	2.02	18200	19.21	4550.0
40-015	Northern Hog Sucker	I	M	S	R	5	10.0	5.05	2760	2.91	276.0
40-023	Smallmouth Redhorse	I	M	S	R	12	24.0	12.12	13500	14.25	562.5
43-008	Streamline Chub	I	R	S	N	1	2.0	1.01	4	0.00	2.0
43-009	Gravel Chub	I	M	S	N	2	4.0	2.02	4	0.00	1.0
43-021	Silver Shiner	I	I	S	N	4	8.0	4.04	30	0.03	3.7
43-032	Spotfin Shiner	I		M	N	5	10.0	5.05	20	0.02	2.0
43-044	Central Stoneroller	H		N	N	4	8.0	4.04	20	0.02	2.5
77-005	Spotted Bass	C		C	F	3	6.0	3.03	420	0.44	70.0
77-006	Largemouth Bass	C		C	F	1	2.0	1.01	10	0.01	5.0
80-001	Sauger	P		S	F	1	2.0	1.01	900	0.95	450.0
80-011	Logperch	I	M	S	D	6	12.0	6.06	80	0.08	6.6
80-013	Eastern Sand Darter	I	R	S	D	1	2.0	1.01	2	0.00	1.0
80-014	Johnny Darter	I		C	D	5	10.0	5.05	10	0.01	1.0
80-020	Tippecanoe Darter	I	R	S	D	1	2.0	1.01	2	0.00	1.0
80-022	Rainbow Darter	I	M	S	D	1	2.0	1.01	2	0.00	1.0
85-001	Freshwater Drum		P	M		5	10.0	5.05	12400	13.09	1240.0

No Species: 23 **Nat. Species:** 24 **Hybrids:** 0 **Total Counted:** 99 **Total Rel. Wt. :** 94764
IBI: 46.0 **MIwb:** 9.5

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR18 River: 02-001 Scioto River RM: 105.25 Date: 09/14/2022
 Time Fished: 2718 Distance: 0.500 Drainge (sq mi): 2610.0 Depth: 0
 Location: dst. Walnut Creek Lat: 39.67098 Long: -82.99101

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		1	2.0	0.28	1000	0.94	500.0
18-002	Mooneye	I	R	M		2	4.0	0.57	900	0.85	225.0
20-003	Gizzard Shad	O		M		9	18.0	2.56	1300	1.22	72.2
40-004	Smallmouth Buffalo	I		M	C	12	24.0	3.42	47800	44.88	1991.6
40-005	Quillback Carpsucker	O		M	C	1	2.0	0.28	1800	1.69	900.0
40-006	River Carpsucker	O		M	C	3	6.0	0.85	4300	4.04	716.6
40-008	Silver Redhorse	I	M	S	R	1	2.0	0.28	5800	5.45	2900.0
40-010	Golden Redhorse	I	M	S	R	4	8.0	1.14	4300	4.04	537.5
40-015	Northern Hog Sucker	I	M	S	R	8	16.0	2.28	2280	2.14	142.5
40-023	Smallmouth Redhorse	I	M	S	R	19	38.0	5.41	23600	22.16	621.0
43-007	Bigeye Chub	I	I	S	N	3	6.0	0.85	16	0.02	2.6
43-008	Streamline Chub	I	R	S	N	5	10.0	1.42	40	0.04	4.0
43-009	Gravel Chub	I	M	S	N	81	162.0	23.08	680	0.64	4.1
43-015	Suckermouth Minnow	I		S	N	37	74.0	10.54	260	0.24	3.5
43-020	Emerald Shiner	I		M	N	58	116.0	16.52	180	0.17	1.5
43-025	Striped Shiner	I		S	N	1	2.0	0.28	2	0.00	1.0
43-032	Spotfin Shiner	I		M	N	5	10.0	1.42	20	0.02	2.0
43-034	Sand Shiner	I	M	M	N	68	136.0	19.37	220	0.21	1.6
43-035	Mimic Shiner	I	I	M	N	2	4.0	0.57	4	0.00	1.0
43-043	Bluntnose Minnow	O	T	C	N	3	6.0	0.85	8	0.01	1.3
43-044	Central Stoneroller	H		N	N	10	20.0	2.85	40	0.04	2.0
47-002	Channel Catfish			C	F	1	2.0	0.28	4800	4.51	2400.0
74-005	Striped Bass X White Bass				E	1	2.0	0.28	1100	1.03	550.0
77-004	Smallmouth Bass	C	M	C	F	2	4.0	0.57	800	0.75	200.0
77-005	Spotted Bass	C		C	F	3	6.0	0.85	60	0.06	10.0
77-009	Bluegill Sunfish	I	P	C	S	1	2.0	0.28	20	0.02	10.0
77-011	Longear Sunfish	I	M	C	S	1	2.0	0.28	10	0.01	5.0
80-011	Logperch	I	M	S	D	2	4.0	0.57	40	0.04	10.0
80-013	Eastern Sand Darter	I	R	S	D	1	2.0	0.28	2	0.00	1.0
80-016	Banded Darter	I	I	S	D	1	2.0	0.28	2	0.00	1.0
80-017	Variagate Darter	I	I	S	D	1	2.0	0.28	10	0.01	5.0
80-020	Tippecanoe Darter	I	R	S	D	1	2.0	0.28	2	0.00	1.0
80-026	Sauger X Walleye	P			E	1	2.0	0.28	1200	1.13	600.0
85-001	Freshwater Drum		P	M		2	4.0	0.57	3900	3.66	975.0

No Species: 31 **Nat. Species:** 32 **Hybrids:** 2 **Total Counted:** 351 **Total Rel. Wt. :** 106496

IBI: 50.0 **MIwb:** 9.7

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR19 River: 02-001 Scioto River RM: 102.00 Date: 08/10/2022
 Time Fished: 2168 Distance: 0.500 Drainge (sq mi): 2640.0 Depth: 0
 Location: dst. Commerical Point Rd. Lat: 39.63284 Long: -82.96212

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
18-002	Mooneye	I	R	M		1	2.0	0.78	150	0.21	75.0
20-001	Skipjack Herring	P		M		1	2.0	0.78	40	0.06	20.0
40-004	Smallmouth Buffalo	I		M	C	2	4.0	1.56	6600	9.24	1650.0
40-005	Quillback Carpsucker	O		M	C	1	2.0	0.78	2000	2.80	1000.0
40-008	Silver Redhorse	I	M	S	R	3	6.0	2.34	11600	16.25	1933.3
40-010	Golden Redhorse	I	M	S	R	2	4.0	1.56	2800	3.92	700.0
40-013	River Redhorse	I	I	S	R	1	2.0	0.78	13300	18.63	6650.0
40-015	Northern Hog Sucker	I	M	S	R	11	22.0	8.59	3120	4.37	141.8
40-023	Smallmouth Redhorse	I	M	S	R	17	34.0	13.28	18400	25.77	541.1
43-007	Bigeye Chub	I	I	S	N	1	2.0	0.78	4	0.01	2.0
43-008	Streamline Chub	I	R	S	N	3	6.0	2.34	46	0.06	7.6
43-009	Gravel Chub	I	M	S	N	32	64.0	25.00	290	0.41	4.5
43-015	Suckermouth Minnow	I		S	N	2	4.0	1.56	12	0.02	3.0
43-020	Emerald Shiner	I		M	N	11	22.0	8.59	20	0.03	0.9
43-025	Striped Shiner	I		S	N	1	2.0	0.78	2	0.00	1.0
43-032	Spotfin Shiner	I		M	N	1	2.0	0.78	6	0.01	3.0
43-043	Bluntnose Minnow	O	T	C	N	1	2.0	0.78	4	0.01	2.0
43-044	Central Stoneroller	H		N	N	2	4.0	1.56	10	0.01	2.5
47-002	Channel Catfish			C	F	2	4.0	1.56	4600	6.44	1150.0
77-005	Spotted Bass	C		C	F	1	2.0	0.78	2	0.00	1.0
77-009	Bluegill Sunfish	I	P	C	S	1	2.0	0.78	20	0.03	10.0
77-011	Longear Sunfish	I	M	C	S	1	2.0	0.78	20	0.03	10.0
80-007	Slenderhead Darter	I	R	S	D	1	2.0	0.78	4	0.01	2.0
80-011	Logperch	I	M	S	D	2	4.0	1.56	60	0.08	15.0
80-015	Greenside Darter	I	M	S	D	4	8.0	3.13	20	0.03	2.5
80-016	Banded Darter	I	I	S	D	7	14.0	5.47	20	0.03	1.4
80-017	Variagate Darter	I	I	S	D	8	16.0	6.25	40	0.06	2.5
80-020	Tippecanoe Darter	I	R	S	D	3	6.0	2.34	6	0.01	1.0
85-001	Freshwater Drum		P	M		4	8.0	3.13	8200	11.48	1025.0
90-002	Mottled Sculpin	I		C		1	2.0	0.78	2	0.00	1.0

No Species: 30 **Nat. Species:** 30 **Hybrids:** 0 **Total Counted:** 128 **Total Rel. Wt. :** 71398
IBI: 48.0 **MIwb:** 9.7

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR19 River: 02-001 Scioto River RM: 102.00 Date: 09/14/2022
 Time Fished: 2302 Distance: 0.500 Drainge (sq mi): 2640.0 Depth: 0
 Location: dst. Commerical Point Rd. Lat: 39.63284 Long: -82.96212

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
01-001	Silver Lamprey	P		N		2	4.0	1.36	70	0.06	17.5
18-002	Mooneye	I	R	M		1	2.0	0.68	400	0.33	200.0
20-003	Gizzard Shad	O		M		7	14.0	4.76	600	0.49	42.8
40-003	Black Buffalo	I		M	C	1	2.0	0.68	7000	5.72	3500.0
40-004	Smallmouth Buffalo	I		M	C	9	18.0	6.12	32000	26.16	1777.7
40-005	Quillback Carpsucker	O		M	C	1	2.0	0.68	1600	1.31	800.0
40-006	River Carpsucker	O		M	C	3	6.0	2.04	5200	4.25	866.6
40-008	Silver Redhorse	I	M	S	R	1	2.0	0.68	5500	4.50	2750.0
40-010	Golden Redhorse	I	M	S	R	4	8.0	2.72	7200	5.89	900.0
40-013	River Redhorse	I	I	S	R	3	6.0	2.04	20000	16.35	3333.3
40-015	Northern Hog Sucker	I	M	S	R	10	20.0	6.80	2290	1.87	114.5
40-023	Smallmouth Redhorse	I	M	S	R	18	36.0	12.24	23100	18.89	641.6
43-001	Common Carp	O	T	M	G	1	2.0	0.68	7700	6.30	3850.0
43-007	Bigeye Chub	I	I	S	N	1	2.0	0.68	4	0.00	2.0
43-008	Streamline Chub	I	R	S	N	5	10.0	3.40	110	0.09	11.0
43-009	Gravel Chub	I	M	S	N	33	66.0	22.45	380	0.31	5.7
43-015	Suckermouth Minnow	I		S	N	3	6.0	2.04	10	0.01	1.6
43-020	Emerald Shiner	I		M	N	22	44.0	14.97	100	0.08	2.2
43-021	Silver Shiner	I	I	S	N	1	2.0	0.68	4	0.00	2.0
43-031	Steelcolor Shiner	I	P	M	N	1	2.0	0.68	10	0.01	5.0
43-032	Spotfin Shiner	I		M	N	3	6.0	2.04	12	0.01	2.0
43-034	Sand Shiner	I	I	M	N	2	4.0	1.36	8	0.01	2.0
43-041	Bullhead Minnow	O		C	N	1	2.0	0.68	6	0.00	3.0
43-043	Bluntnose Minnow	O	T	C	N	1	2.0	0.68	6	0.00	3.0
77-004	Smallmouth Bass	C	M	C	F	2	4.0	1.36	500	0.41	125.0
77-005	Spotted Bass	C		C	F	2	4.0	1.36	60	0.05	15.0
80-011	Logperch	I	M	S	D	4	8.0	2.72	40	0.03	5.0
80-017	Variagate Darter	I	I	S	D	1	2.0	0.68	6	0.00	3.0
80-022	Rainbow Darter	I	M	S	D	1	2.0	0.68	2	0.00	1.0
80-026	Sauger X Walleye	P			E	1	2.0	0.68	2700	2.21	1350.0
85-001	Freshwater Drum		P	M		2	4.0	1.36	5700	4.66	1425.0

No Species: 29 **Nat. Species:** 29 **Hybrids:** 1 **Total Counted:** 147 **Total Rel. Wt. :** 122318
IBI: 50.0 **MIwb:** 9.9

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR20 River: 02-001 Scioto River RM: 100.24 Date: 09/01/2022
 Time Fished: 4187 Distance: 0.650 Drainge (sq mi): 3200.0 Depth: 0
 Location: Circleville Riffle_ust. US 22 Lat: 39.60781 Long: -82.95931

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		9	13.8	4.35	1845	2.04	133.3
40-004	Smallmouth Buffalo	I		M	C	2	3.1	0.97	5152	5.71	1675.0
40-006	River Carpsucker	O		M	C	12	18.5	5.80	13995	15.51	758.3
40-008	Silver Redhorse	I	M	S	R	1	1.5	0.48	2768	3.07	1800.0
40-010	Golden Redhorse	I	M	S	R	3	4.6	1.45	2922	3.24	633.3
40-015	Northern Hog Sucker	I	M	S	R	9	13.8	4.35	4352	4.82	314.4
40-023	Smallmouth Redhorse	I	M	S	R	13	20.0	6.28	12842	14.23	642.3
43-001	Common Carp	O	T	M	G	4	6.2	1.93	15456	17.13	2512.5
43-008	Streamline Chub	I	R	S	N	7	10.8	3.38	99	0.11	9.2
43-009	Gravel Chub	I	M	S	N	3	4.6	1.45	15	0.02	3.3
43-015	Suckermouth Minnow	I		S	N	1	1.5	0.48	4	0.01	3.0
43-020	Emerald Shiner	I		M	N	70	107.7	33.82	123	0.14	1.1
43-032	Spotfin Shiner	I		M	N	7	10.8	3.38	18	0.02	1.7
43-034	Sand Shiner	I	I	M	N	5	7.7	2.42	13	0.02	1.8
43-035	Mimic Shiner	I	I	M	N	3	4.6	1.45	9	0.01	2.0
43-041	Bullhead Minnow	O		C	N	1	1.5	0.48	3	0.00	2.0
43-043	Bluntnose Minnow	O	T	C	N	3	4.6	1.45	9	0.01	2.0
43-044	Central Stoneroller	H		N	N	3	4.6	1.45	4	0.01	1.0
47-002	Channel Catfish			C	F	4	6.2	1.93	6382	7.07	1037.5
47-007	Flathead Catfish	P		C	F	2	3.1	0.97	7074	7.84	2300.0
77-002	Black Crappie	I		C	S	1	1.5	0.48	84	0.09	55.0
77-004	Smallmouth Bass	C	M	C	F	13	20.0	6.28	3598	3.99	180.0
77-005	Spotted Bass	C		C	F	3	4.6	1.45	46	0.05	10.0
77-006	Largemouth Bass	C		C	F	2	3.1	0.97	30	0.03	10.0
77-009	Bluegill Sunfish	I	P	C	S	2	3.1	0.97	76	0.09	25.0
77-011	Longear Sunfish	I	M	C	S	4	6.2	1.93	61	0.07	10.0
80-011	Logperch	I	M	S	D	1	1.5	0.48	7	0.01	5.0
80-015	Greenside Darter	I	M	S	D	3	4.6	1.45	7	0.01	1.6
80-017	Variagate Darter	I	I	S	D	5	7.7	2.42	15	0.02	2.0
80-019	Bluebreast Darter	I	R	S	D	1	1.5	0.48	3	0.00	2.0
80-020	Tippecanoe Darter	I	R	S	D	3	4.6	1.45	3	0.00	0.6
80-026	Sauger X Walleye	P			E	1	1.5	0.48	1922	2.13	1250.0
85-001	Freshwater Drum		P	M		6	9.2	2.90	11304	12.52	1225.0

No Species: 31 **Nat. Species:** 31 **Hybrids:** 1 **Total Counted:** 207 **Total Rel. Wt. :** 90257

IBI: 50.0 **MIwb:** 9.8

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR20 River: 02-001 Scioto River RM: 100.24 Date: 10/14/2022
 Time Fished: 4259 Distance: 0.650 Drainge (sq mi): 3200.0 Depth: 0
 Location: Circleville Riffle_ust. US 22 Lat: 39.60781 Long: -82.95931

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		1	1.5	0.53	922	1.27	600.0
18-002	Mooneye	I	R	M		1	1.5	0.53	76	0.11	50.0
20-003	Gizzard Shad	O		M		2	3.1	1.06	1230	1.69	400.0
40-002	Bigmouth Buffalo	I		M	C	1	1.5	0.53	1999	2.75	1300.0
40-004	Smallmouth Buffalo	I		M	C	3	4.6	1.60	11304	15.55	2450.0
40-006	River Carpsucker	O		M	C	3	4.6	1.60	4306	5.92	933.3
40-008	Silver Redhorse	I	M	S	R	1	1.5	0.53	2230	3.07	1450.0
40-010	Golden Redhorse	I	M	S	R	1	1.5	0.53	1153	1.59	750.0
40-015	Northern Hog Sucker	I	M	S	R	9	13.8	4.79	3791	5.22	273.8
40-023	Smallmouth Redhorse	I	M	S	R	8	12.3	4.26	9535	13.12	775.0
43-001	Common Carp	O	T	M	G	1	1.5	0.53	1999	2.75	1300.0
43-007	Bigeye Chub	I	I	S	N	2	3.1	1.06	4	0.01	1.5
43-020	Emerald Shiner	I		M	N	100	153.8	53.19	307	0.42	2.0
43-021	Silver Shiner	I	I	S	N	3	4.6	1.60	30	0.04	6.6
43-022	Rosyface Shiner	I	I	S	N	1	1.5	0.53	1	0.00	1.0
43-032	Spotfin Shiner	I		M	N	9	13.8	4.79	46	0.06	3.3
43-034	Sand Shiner	I	I	M	N	1	1.5	0.53	1	0.00	1.0
43-035	Mimic Shiner	I	I	M	N	1	1.5	0.53	1	0.00	1.0
43-041	Bullhead Minnow	O		C	N	2	3.1	1.06	6	0.01	2.0
43-044	Central Stoneroller	H		N	N	1	1.5	0.53	6	0.01	4.0
43-047	Grass Carp			M	E	1	1.5	0.53	17994	24.75	11700.0
47-002	Channel Catfish			C	F	2	3.1	1.06	2614	3.60	850.0
70-001	Brook Silverside	I	M	M		1	1.5	0.53	1	0.00	1.0
77-002	Black Crappie	I		C	S	1	1.5	0.53	23	0.03	15.0
77-004	Smallmouth Bass	C	M	C	F	2	3.1	1.06	23	0.03	7.5
77-005	Spotted Bass	C		C	F	14	21.5	7.45	1645	2.26	76.4
77-006	Largemouth Bass	C		C	F	3	4.6	1.60	123	0.17	26.6
77-008	Green Sunfish	I	T	C	S	1	1.5	0.53	53	0.07	35.0
77-009	Bluegill Sunfish	I	P	C	S	2	3.1	1.06	23	0.03	7.5
77-011	Longear Sunfish	I	M	C	S	2	3.1	1.06	76	0.11	25.0
80-001	Sauger	P		S	F	1	1.5	0.53	461	0.63	300.0
80-017	Variagate Darter	I	I	S	D	2	3.1	1.06	7	0.01	2.5
80-026	Sauger X Walleye	P			E	1	1.5	0.53	2460	3.39	1600.0
85-001	Freshwater Drum		P	M		3	4.6	1.60	8228	11.32	1783.3
90-002	Mottled Sculpin	I		C		1	1.5	0.53	3	0.00	2.0

No Species: 33 **Nat. Species:** 32 **Hybrids:** 1 **Total Counted:** 188 **Total Rel. Wt. :** 72696
IBI: 50.0 **MIwb:** 9.1

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR21 River: 02-001 Scioto River RM: 99.52 Date: 09/01/2022
 Time Fished: 3071 Distance: 0.500 Drainge (sq mi): 3220.0 Depth: 0
 Location: ust. Circleville WWTP Lat: 39.59769 Long: -82.95601

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		3	6.0	1.88	4000	4.75	666.6
18-002	Mooneye	I	R	M		1	2.0	0.63	200	0.24	100.0
20-003	Gizzard Shad	O		M		4	8.0	2.50	2000	2.38	250.0
40-003	Black Buffalo	I		M	C	1	2.0	0.63	6000	7.13	3000.0
40-004	Smallmouth Buffalo	I		M	C	3	6.0	1.88	9000	10.69	1500.0
40-006	River Carpsucker	O		M	C	2	4.0	1.25	8700	10.34	2175.0
40-008	Silver Redhorse	I	M	S	R	3	6.0	1.88	12000	14.26	2000.0
40-010	Golden Redhorse	I	M	S	R	1	2.0	0.63	1700	2.02	850.0
40-015	Northern Hog Sucker	I	M	S	R	3	6.0	1.88	1800	2.14	300.0
40-022	Bigmouth Buffalo X Smallmouth Buffalo			M	C	1	2.0	0.63	16200	19.25	8100.0
40-023	Smallmouth Redhorse	I	M	S	R	12	24.0	7.50	13200	15.68	550.0
43-001	Common Carp	O	T	M	G	1	2.0	0.63	7100	8.44	3550.0
43-007	Bigeye Chub	I	I	S	N	3	6.0	1.88	8	0.01	1.3
43-008	Streamline Chub	I	R	S	N	4	8.0	2.50	60	0.07	7.5
43-009	Gravel Chub	I	M	S	N	24	48.0	15.00	300	0.36	6.2
43-015	Suckermouth Minnow	I		S	N	1	2.0	0.63	10	0.01	5.0
43-020	Emerald Shiner	I		M	N	50	100.0	31.25	150	0.18	1.5
43-031	Steelcolor Shiner	I	P	M	N	1	2.0	0.63	40	0.05	20.0
43-032	Spotfin Shiner	I		M	N	8	16.0	5.00	60	0.07	3.7
43-034	Sand Shiner	I	I	M	N	1	2.0	0.63	4	0.00	2.0
43-041	Bullhead Minnow	O		C	N	2	4.0	1.25	20	0.02	5.0
43-044	Central Stoneroller	H		N	N	6	12.0	3.75	140	0.17	11.6
77-004	Smallmouth Bass	C	M	C	F	1	2.0	0.63	10	0.01	5.0
77-005	Spotted Bass	C		C	F	1	2.0	0.63	90	0.11	45.0
77-008	Green Sunfish	I	T	C	S	3	6.0	1.88	60	0.07	10.0
77-009	Bluegill Sunfish	I	P	C	S	1	2.0	0.63	10	0.01	5.0
77-011	Longear Sunfish	I	M	C	S	2	4.0	1.25	40	0.05	10.0
80-004	Ducky Darter	I	M	S	D	1	2.0	0.63	18	0.02	9.0
80-005	Blackside Darter	I		S	D	1	2.0	0.63	4	0.00	2.0
80-016	Banded Darter	I	I	S	D	1	2.0	0.63	2	0.00	1.0
80-017	Variegate Darter	I	I	S	D	7	14.0	4.38	30	0.04	2.1
80-019	Bluebreast Darter	I	R	S	D	2	4.0	1.25	4	0.00	1.0
80-020	Tippecanoe Darter	I	R	S	D	1	2.0	0.63	2	0.00	1.0
80-022	Rainbow Darter	I	M	S	D	2	4.0	1.25	6	0.01	1.5
85-001	Freshwater Drum		P	M		2	4.0	1.25	1200	1.43	300.0

No Species: 33 **Nat. Species:** 33 **Hybrids:** 1 **Total Counted:** 160 **Total Rel. Wt. :** 84168
IBI: 48.0 **MIwb:** 9.4

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR21 River: 02-001 Scioto River RM: 99.52 Date: 10/14/2022
 Time Fished: 3428 Distance: 0.500 Drainge (sq mi): 3220.0 Depth: 0
 Location: ust. Circleville WWTP Lat: 39.59769 Long: -82.95601

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
18-002	Mooneye	I	R	M		1	2.0	0.52	500	0.72	250.0
20-003	Gizzard Shad	O		M		9	18.0	4.66	2640	3.81	146.6
40-004	Smallmouth Buffalo	I		M	C	7	14.0	3.63	24000	34.61	1714.2
40-006	River Carpsucker	O		M	C	3	6.0	1.55	5000	7.21	833.3
40-008	Silver Redhorse	I	M	S	R	1	2.0	0.52	3600	5.19	1800.0
40-010	Golden Redhorse	I	M	S	R	1	2.0	0.52	1300	1.87	650.0
40-013	River Redhorse	I	I	S	R	1	2.0	0.52	8200	11.82	4100.0
40-015	Northern Hog Sucker	I	M	S	R	3	6.0	1.55	1200	1.73	200.0
40-023	Smallmouth Redhorse	I	M	S	R	5	10.0	2.59	5140	7.41	514.0
43-001	Common Carp	O	T	M	G	2	4.0	1.04	7400	10.67	1850.0
43-007	Bigeye Chub	I	I	S	N	3	6.0	1.55	20	0.03	3.3
43-008	Streamline Chub	I	R	S	N	3	6.0	1.55	30	0.04	5.0
43-009	Gravel Chub	I	M	S	N	3	6.0	1.55	20	0.03	3.3
43-015	Suckermouth Minnow	I		S	N	1	2.0	0.52	10	0.01	5.0
43-020	Emerald Shiner	I		M	N	84	168.0	43.52	340	0.49	2.0
43-021	Silver Shiner	I	I	S	N	13	26.0	6.74	140	0.20	5.3
43-022	Rosyface Shiner	I	I	S	N	3	6.0	1.55	6	0.01	1.0
43-025	Striped Shiner	I		S	N	1	2.0	0.52	2	0.00	1.0
43-032	Spotfin Shiner	I		M	N	7	14.0	3.63	50	0.07	3.5
43-041	Bullhead Minnow	O		C	N	1	2.0	0.52	2	0.00	1.0
43-043	Bluntnose Minnow	O	T	C	N	2	4.0	1.04	10	0.01	2.5
43-044	Central Stoneroller	H		N	N	2	4.0	1.04	20	0.03	5.0
47-002	Channel Catfish			C	F	1	2.0	0.52	2000	2.88	1000.0
47-007	Flathead Catfish	P		C	F	1	2.0	0.52	500	0.72	250.0
77-004	Smallmouth Bass	C	M	C	F	5	10.0	2.59	840	1.21	84.0
77-005	Spotted Bass	C		C	F	5	10.0	2.59	1890	2.73	189.0
77-006	Largemouth Bass	C		C	F	1	2.0	0.52	50	0.07	25.0
77-008	Green Sunfish	I	T	C	S	5	10.0	2.59	10	0.01	1.0
77-009	Bluegill Sunfish	I	P	C	S	1	2.0	0.52	20	0.03	10.0
77-011	Longear Sunfish	I	M	C	S	1	2.0	0.52	30	0.04	15.0
80-016	Banded Darter	I	I	S	D	1	2.0	0.52	2	0.00	1.0
80-017	Variagate Darter	I	I	S	D	6	12.0	3.11	60	0.09	5.0
80-019	Bluebreast Darter	I	R	S	D	2	4.0	1.04	6	0.01	1.5
80-020	Tippecanoe Darter	I	R	S	D	4	8.0	2.07	8	0.01	1.0
80-026	Sauger X Walleye	P			E	1	2.0	0.52	1100	1.59	550.0
85-001	Freshwater Drum		P	M		2	4.0	1.04	3200	4.61	800.0
90-002	Mottled Sculpin	I		C		1	2.0	0.52	6	0.01	3.0

No Species: 35 **Nat. Species:** 35 **Hybrids:** 1 **Total Counted:** 193 **Total Rel. Wt. :** 69352
IBI: 48.0 **MIwb:** 9.5

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR22 River: 02-001 Scioto River RM: 98.65 Date: 09/01/2022
 Time Fished: 2514 Distance: 0.500 Drainge (sq mi): 3220.0 Depth: 0
 Location: dst. Circleville WWTP Lat: 39.59874 Long: -82.97050

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-004	Smallmouth Buffalo	I		M	C	9	18.0	11.69	28000	32.19	1555.5
40-006	River Carpsucker	O		M	C	2	4.0	2.60	3200	3.68	800.0
40-013	River Redhorse	I	I	S	R	2	4.0	2.60	14300	16.44	3575.0
40-015	Northern Hog Sucker	I	M	S	R	1	2.0	1.30	1600	1.84	800.0
40-023	Smallmouth Redhorse	I	M	S	R	12	24.0	15.58	14820	17.04	617.5
43-001	Common Carp	O	T	M	G	2	4.0	2.60	9000	10.35	2250.0
43-007	Bigeye Chub	I	I	S	N	1	2.0	1.30	4	0.00	2.0
43-008	Streamline Chub	I	R	S	N	2	4.0	2.60	12	0.01	3.0
43-020	Emerald Shiner	I		M	N	9	18.0	11.69	20	0.02	1.1
43-032	Spotfin Shiner	I		M	N	8	16.0	10.39	60	0.07	3.7
43-041	Bullhead Minnow	O		C	N	1	2.0	1.30	6	0.01	3.0
43-044	Central Stoneroller	H		N	N	2	4.0	2.60	12	0.01	3.0
47-002	Channel Catfish			C	F	1	2.0	1.30	3300	3.79	1650.0
47-007	Flathead Catfish	P		C	F	1	2.0	1.30	600	0.69	300.0
77-002	Black Crappie	I		C	S	1	2.0	1.30	500	0.57	250.0
77-004	Smallmouth Bass	C	M	C	F	5	10.0	6.49	1120	1.29	112.0
77-005	Spotted Bass	C		C	F	4	8.0	5.19	1206	1.39	150.7
77-008	Green Sunfish	I	T	C	S	3	6.0	3.90	10	0.01	1.6
77-009	Bluegill Sunfish	I	P	C	S	2	4.0	2.60	10	0.01	2.5
80-011	Logperch	I	M	S	D	2	4.0	2.60	10	0.01	2.5
80-020	Tippecanoe Darter	I	R	S	D	1	2.0	1.30	2	0.00	1.0
85-001	Freshwater Drum		P	M		6	12.0	7.79	9200	10.58	766.6

No Species: 22 **Nat. Species:** 21 **Hybrids:** 0 **Total Counted:** 77 **Total Rel. Wt. :** 86992

IBI: 48.0 **MIwb:** 9.4

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR22 River: 02-001 Scioto River RM: 98.65 Date: 10/14/2022
 Time Fished: 2745 Distance: 0.500 Drainge (sq mi): 3220.0 Depth: 0
 Location: dst. Circleville WWTP Lat: 39.59874 Long: -82.97050

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
18-002	Mooneye	I	R	M		1	2.0	1.18	500	0.77	250.0
20-001	Skipjack Herring	P		M		1	2.0	1.18	200	0.31	100.0
20-003	Gizzard Shad	O		M		2	4.0	2.35	820	1.27	205.0
40-004	Smallmouth Buffalo	I		M	C	6	12.0	7.06	24000	37.05	2000.0
40-006	River Carpsucker	O		M	C	1	2.0	1.18	1600	2.47	800.0
40-008	Silver Redhorse	I	M	S	R	1	2.0	1.18	3100	4.79	1550.0
40-010	Golden Redhorse	I	M	S	R	2	4.0	2.35	3300	5.09	825.0
40-023	Smallmouth Redhorse	I	M	S	R	11	22.0	12.94	16700	25.78	759.0
43-007	Bigeye Chub	I	I	S	N	1	2.0	1.18	4	0.01	2.0
43-020	Emerald Shiner	I		M	N	9	18.0	10.59	40	0.06	2.2
43-021	Silver Shiner	I	I	S	N	5	10.0	5.88	60	0.09	6.0
43-032	Spotfin Shiner	I		M	N	1	2.0	1.18	8	0.01	4.0
43-034	Sand Shiner	I	I	M	N	2	4.0	2.35	2	0.00	0.5
43-041	Bullhead Minnow	O		C	N	4	8.0	4.71	14	0.02	1.7
43-043	Bluntnose Minnow	O	T	C	N	8	16.0	9.41	10	0.02	0.6
43-044	Central Stoneroller	H		N	N	2	4.0	2.35	20	0.03	5.0
47-002	Channel Catfish			C	F	1	2.0	1.18	5200	8.03	2600.0
47-007	Flathead Catfish	P		C	F	1	2.0	1.18	160	0.25	80.0
77-004	Smallmouth Bass	C	M	C	F	6	12.0	7.06	840	1.30	70.0
77-005	Spotted Bass	C		C	F	11	22.0	12.94	1360	2.10	61.8
77-008	Green Sunfish	I	T	C	S	3	6.0	3.53	6	0.01	1.0
77-009	Bluegill Sunfish	I	P	C	S	1	2.0	1.18	30	0.05	15.0
80-004	Ducky Darter	I	M	S	D	1	2.0	1.18	4	0.01	2.0
80-023	Orangethroat Darter	I		S	D	1	2.0	1.18	4	0.01	2.0
85-001	Freshwater Drum		P	M		3	6.0	3.53	6800	10.50	1133.3

No Species: 24 **Nat. Species:** 25 **Hybrids:** 0 **Total Counted:** 85 **Total Rel. Wt. :** 64782
IBI: 44.0 **MIwb:** 9.1

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR23 River: 02-001 Scioto River RM: 98.01 Date: 09/01/2022
 Time Fished: 3205 Distance: 0.500 Drainge (sq mi): 3220.0 Depth: 0
 Location: dst. Wicket Dam at Canal Park Lat: 39.58976 Long: -82.97161

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
18-002	Mooneye	I	R	M		1	2.0	0.67	400	0.51	200.0
20-003	Gizzard Shad	O		M		2	4.0	1.33	500	0.64	125.0
40-003	Black Buffalo	I		M	C	1	2.0	0.67	7200	9.18	3600.0
40-004	Smallmouth Buffalo	I		M	C	4	8.0	2.67	20400	26.00	2550.0
40-005	Quillback Carpsucker	O		M	C	1	2.0	0.67	2000	2.55	1000.0
40-006	River Carpsucker	O		M	C	1	2.0	0.67	1600	2.04	800.0
40-008	Silver Redhorse	I	M	S	R	2	4.0	1.33	7600	9.69	1900.0
40-013	River Redhorse	I	I	S	R	1	2.0	0.67	6400	8.16	3200.0
40-015	Northern Hog Sucker	I	M	S	R	23	46.0	15.33	9400	11.98	204.3
40-023	Smallmouth Redhorse	I	M	S	R	9	18.0	6.00	12400	15.81	688.8
43-007	Bigeye Chub	I	I	S	N	2	4.0	1.33	12	0.02	3.0
43-008	Streamline Chub	I	R	S	N	2	4.0	1.33	30	0.04	7.5
43-009	Gravel Chub	I	M	S	N	24	48.0	16.00	244	0.31	5.0
43-015	Suckermouth Minnow	I		S	N	2	4.0	1.33	12	0.02	3.0
43-020	Emerald Shiner	I		M	N	12	24.0	8.00	10	0.01	0.4
43-021	Silver Shiner	I	I	S	N	1	2.0	0.67	6	0.01	3.0
43-032	Spotfin Shiner	I		M	N	6	12.0	4.00	60	0.08	5.0
43-034	Sand Shiner	I	I	M	N	5	10.0	3.33	30	0.04	3.0
43-044	Central Stoneroller	H		N	N	9	18.0	6.00	60	0.08	3.3
47-008	Stonecat Madtom	I	I	C		1	2.0	0.67	10	0.01	5.0
77-004	Smallmouth Bass	C	M	C	F	5	10.0	3.33	2500	3.19	250.0
77-005	Spotted Bass	C		C	F	1	2.0	0.67	400	0.51	200.0
77-006	Largemouth Bass	C		C	F	2	4.0	1.33	20	0.03	5.0
77-008	Green Sunfish	I	T	C	S	2	4.0	1.33	20	0.03	5.0
77-009	Bluegill Sunfish	I	P	C	S	3	6.0	2.00	60	0.08	10.0
80-016	Banded Darter	I	I	S	D	7	14.0	4.67	10	0.01	0.7
80-017	Variagate Darter	I	I	S	D	12	24.0	8.00	40	0.05	1.6
80-019	Bluebreast Darter	I	R	S	D	2	4.0	1.33	20	0.03	5.0
80-020	Tippecanoe Darter	I	R	S	D	3	6.0	2.00	6	0.01	1.0
85-001	Freshwater Drum		P	M		4	8.0	2.67	7000	8.92	875.0

No Species: 29 **Nat. Species:** 30 **Hybrids:** 0 **Total Counted:** 150 **Total Rel. Wt. :** 78450
IBI: 52.0 **MIwb:** 10.0

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

Site ID: SR23 River: 02-001 Scioto River RM: 98.01 Date: 10/14/2022
 Time Fished: 2797 Distance: 0.500 Drainge (sq mi): 3220.0 Depth: 0
 Location: dst. Wicket Dam at Canal Park Lat: 39.58976 Long: -82.97161

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
18-002	Mooneye	I	R	M		1	2.0	0.81	1000	1.80	500.0
20-003	Gizzard Shad	O		M		3	6.0	2.42	700	1.26	116.6
40-004	Smallmouth Buffalo	I		M	C	3	6.0	2.42	14300	25.72	2383.3
40-005	Quillback Carpsucker	O		M	C	1	2.0	0.81	2300	4.14	1150.0
40-010	Golden Redhorse	I	M	S	R	1	2.0	0.81	10	0.02	5.0
40-013	River Redhorse	I	I	S	R	1	2.0	0.81	5300	9.53	2650.0
40-015	Northern Hog Sucker	I	M	S	R	10	20.0	8.06	6140	11.04	307.0
40-023	Smallmouth Redhorse	I	M	S	R	8	16.0	6.45	10820	19.46	676.2
43-001	Common Carp	O	T	M	G	1	2.0	0.81	7600	13.67	3800.0
43-008	Streamline Chub	I	R	S	N	9	18.0	7.26	100	0.18	5.5
43-009	Gravel Chub	I	M	S	N	18	36.0	14.52	160	0.29	4.4
43-020	Emerald Shiner	I		M	N	13	26.0	10.48	68	0.12	2.6
43-021	Silver Shiner	I	I	S	N	2	4.0	1.61	10	0.02	2.5
43-022	Rosyface Shiner	I	I	S	N	1	2.0	0.81	2	0.00	1.0
43-025	Striped Shiner	I		S	N	1	2.0	0.81	6	0.01	3.0
43-031	Steelcolor Shiner	I	P	M	N	2	4.0	1.61	12	0.02	3.0
43-032	Spotfin Shiner	I		M	N	1	2.0	0.81	4	0.01	2.0
43-034	Sand Shiner	I	I	M	N	1	2.0	0.81	4	0.01	2.0
43-035	Mimic Shiner	I	I	M	N	2	4.0	1.61	4	0.01	1.0
43-041	Bullhead Minnow	O		C	N	3	6.0	2.42	16	0.03	2.6
43-043	Bluntnose Minnow	O	T	C	N	2	4.0	1.61	6	0.01	1.5
43-044	Central Stoneroller	H		N	N	4	8.0	3.23	70	0.13	8.7
47-002	Channel Catfish			C	F	1	2.0	0.81	2400	4.32	1200.0
47-007	Flathead Catfish	P		C	F	1	2.0	0.81	200	0.36	100.0
47-008	Stonecat Madtom	I	I	C		1	2.0	0.81	30	0.05	15.0
70-001	Brook Silverside	I	M	M		1	2.0	0.81	2	0.00	1.0
77-004	Smallmouth Bass	C	M	C	F	2	4.0	1.61	1500	2.70	375.0
77-005	Spotted Bass	C		C	F	3	6.0	2.42	220	0.40	36.6
77-006	Largemouth Bass	C		C	F	1	2.0	0.81	60	0.11	30.0
77-008	Green Sunfish	I	T	C	S	1	2.0	0.81	10	0.02	5.0
77-009	Bluegill Sunfish	I	P	C	S	1	2.0	0.81	10	0.02	5.0
77-011	Longear Sunfish	I	M	C	S	2	4.0	1.61	160	0.29	40.0
80-011	Logperch	I	M	S	D	3	6.0	2.42	60	0.11	10.0
80-015	Greenside Darter	I	M	S	D	4	8.0	3.23	20	0.04	2.5
80-016	Banded Darter	I	I	S	D	3	6.0	2.42	10	0.02	1.6
80-017	Variagate Darter	I	I	S	D	10	20.0	8.06	80	0.14	4.0
80-022	Rainbow Darter	I	M	S	D	1	2.0	0.81	4	0.01	2.0
85-001	Freshwater Drum		P	M		1	2.0	0.81	2200	3.96	1100.0

Appendix Table B-4. Midwest Biodiversity Institute Fish Species List

No Species: 37	Nat. Species: 37	Hybrids: 0	Total Counted: 124	Total Rel. Wt. : 55598
IBI: 50.0	MIwb: 9.9			

APPENDIX B: OLENTANGY RIVER MAINSTEM FISH ASSEMBLAGE DATA

B-5: Olentangy River IBI Metrics, IBI Scores, and MIwb Scores 2022

B-6: Olentangy River Fish Species Grand (all sites combined) 2022

B-7: Fish Species Abundance Ust. Dodridge Dam 2022

B-8: Fish Species Abundance Dst. Dodridge Dam 2022

B-9: Olentangy River Fish Species by Site and Sample 2022

Appendix Table B-5. Boatable Ohio IBI scores and metrics for data collected in the Olentangy River mainstem in 2022.

Site ID	River Mile	Type	Drainage Date	Drainage area (sq mi)	Number of				Percent of Individuals						DELTA anomalies	Rel.No. minus tolerants /(1.0 km)	Modified		
					Total species	Sunfish species	Sucker species	Intolerant species	Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores			IBI	lwb	Source
Olentangy River - (02400)																			
Year: 2022																			
OLN05	14.90	P	07/15/2022	482	24(5)	4(5)	5(3)	5(5)	29(3)	36(3)	17(3)	17(3)	14(5)	62(5)	1.4(3)	490(5)	48	9.9	MBI
OLN07	12.90	D	08/19/2022	489	25(5)	4(5)	4(3)	6(5)	21(0)	31(3)	27(3)	24(3)	15(5)	56(5)	1.2(3)	186(1)	46	8.9	MBI
OLN08	12.30	D	08/19/2022	497	21(3)	4(5)	3(3)	3(3)	38(0)	51(5)	10(5)	6(5)	14(5)	78(5)	0.6(3)	163(1) *	46	8.5	MBI
OLN09	8.50	P	08/30/2022	510	20(3)	2(3)	5(3)	5(5)	37(3)	60(5)	2(5)	5(5)	12(5)	74(5)	0.7(5)	286(3)	50	9.3	MBI
OLN10	7.10	P	08/30/2022	516	20(3)	3(3)	4(3)	4(5)	45(5)	62(5)	4(5)	4(5)	8(3)	75(5)	2.2(3)	440(5)	50	9.4	MBI
OLN11	5.82	P	08/30/2022	524	12(3)	3(3)	2(1)	1(1)	35(3)	39(3)	34(1)	14(5)	11(5)	72(5)	5.5(1)	112(1) *	32	7.3	MBI
OLN12	4.45	P	08/29/2022	529	15(3)	5(5)	2(1)	1(1)	29(3)	37(3)	27(1)	10(5)	17(5)	73(5)	1.5(3)	200(3)	38	7.9	MBI
OLN01	3.95	P	09/02/2022	531	31(5)	6(5)	6(5)	6(5)	28(3)	44(3)	22(3)	9(5)	6(3)	77(5)	3.2(1)	442(5)	48	10.2	MBI
OLN02	2.00	P	08/15/2022	540	25(5)	3(3)	6(5)	8(5)	33(3)	50(5)	7(5)	14(5)	8(3)	70(5)	5.0(1)	296(3)	48	9.9	MBI
OLN03	1.80	P	08/15/2022	540	28(5)	4(5)	7(5)	8(5)	30(3)	38(3)	9(5)	15(5)	6(3)	62(5)	3.9(1)	378(3)	48	10.4	MBI
OLN04	0.20	D	08/19/2022	543	27(5)	2(3)	6(5)	6(5)	19(0)	64(5)	4(5)	3(5)	2(3)	77(5)	0.8(3)	237(3)	52	8.9	MBI

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

Appendix Table B-6. Grand totals for fish species sampled in the Olentangy River by MBI in 2022.

Family Code	Species Code	Common Name	Latin Name	Ohio Tolerance	Number/km	% by Number	Kg/km	% by Biomass	No. of Samples
40	010	Golden Redhorse	Moxostoma erythrurum	M	643	16.10	426.82	30.27	11
40	015	Northern Hog Sucker	Hypentelium nigricans	M	376	9.76	97.37	6.90	10
77	004	Smallmouth Bass	Micropterus dolomieu	M	267	7.11	75.76	5.37	11
43	032	Spotfin Shiner	Cyprinella spiloptera		272	7.02	2.10	0.15	11
43	043	Bluntnose Minnow	Pimephales notatus	T	190	5.80	1.24	0.09	11
43	021	Silver Shiner	Notropis photogenis	I	238	5.80	1.88	0.13	10
77	008	Green Sunfish	Lepomis cyanellus	T	233	5.67	2.37	0.17	10
43	044	Central Stoneroller	Campostoma anomalum		185	5.31	1.72	0.12	9
77	009	Bluegill Sunfish	Lepomis macrochirus	P	186	4.90	4.19	0.30	11
43	015	Suckermouth Minnow	Phenacobius mirabilis		88	3.60	1.16	0.08	3
40	009	Black Redhorse	Moxostoma duquesnei	I	106	3.10	125.29	8.88	9
47	002	Channel Catfish	Ictalurus punctatus		129	3.06	170.99	12.12	9
43	034	Sand Shiner	Miniellus stramineus	M	94	2.92	0.48	0.03	8
43	001	Common Carp	Cyprinus carpio	T	109	2.65	256.50	18.19	10
80	016	Banded Darter	Etheostoma zonale	I	68	2.25	0.13	0.01	9
80	011	Logperch	Percina caprodes	M	79	1.93	1.18	0.08	10
40	005	Quillback Carpsucker	Carpodes cyprinus		63	1.44	50.17	3.56	8
20	003	Gizzard Shad	Dorosoma cepedianum		61	1.39	6.69	0.47	7
77	003	Rock Bass	Ambloplites rupestris		47	1.35	4.23	0.30	8
80	019	Bluebreast Darter	Nothonotus camurus	R	36	0.90	0.10	0.01	8
40	008	Silver Redhorse	Moxostoma anisurum	M	34	0.85	75.46	5.35	6
80	022	Rainbow Darter	Etheostoma caeruleum	M	20	0.81	0.07	0.00	5
77	011	Longear Sunfish	Lepomis megalotis	M	33	0.76	0.75	0.05	6
77	006	Largemouth Bass	Micropterus nigricans		29	0.72	0.21	0.02	7
80	024	Fantail Darter	Etheostoma flabellare		17	0.58	0.04	0.00	6
80	015	Greenside Darter	Etheostoma blennioides	M	15	0.49	0.04	0.00	5
40	013	River Redhorse	Moxostoma carinatum	I	21	0.49	57.53	4.08	4
47	008	Stonecat Madtom	Noturus flavus	I	18	0.45	0.47	0.03	6
80	014	Johnny Darter	Etheostoma nigrum		11	0.36	0.02	0.00	6
80	026	Sauger X Walleye	HYBRID		16	0.36	10.00	0.71	3

Appendix Table B-6. continued.

70	001	Brook Silverside	Labidesthes sicculus	M	11	0.27	0.02	0.00	4
77	015	Green X Bluegill Sunfish	HYBRID		9	0.27	0.54	0.04	5
43	005	River Chub	Nocomis micropogon	I	9	0.22	0.08	0.01	3
40	004	Smallmouth Buffalo	Ictiobus bubalus		10	0.22	23.30	1.65	2
74	005	Striped Bass X White Bass	HYBRID		10	0.22	1.13	0.08	3
47	007	Flathead Catfish	Pylodictis olivaris		7	0.18	9.53	0.68	4
43	022	Rosyface Shiner	Notropis rubellus	I	6	0.18	0.03	0.00	3
77	010	Orangespotted Sunfish	Lepomis humilis		6	0.13	0.05	0.00	1
77	002	Black Crappie	Pomoxis nigromaculatus		4	0.09	0.13	0.01	2
77	013	Pumpkinseed Sunfish	Lepomis gibbosus	P	3	0.09	0.10	0.01	2
47	012	Brindled Madtom	Noturus miurus	I	1	0.04	0.03	0.00	1
43	013	Creek Chub	Semotilus atromaculatus	T	1	0.04	0.01	0.00	1
74	001	White Bass	Morone chrysops		2	0.04	0.28	0.02	1
		40 species, 1 non-native species, 3 hybrids							

Appendix Table B-7. Grand totals for fish species sampled in the Olentangy River by MBI upstream Dodridge Dam in 2022.

Family Code	Species Code	Common Name	Latin Name	Ohio Tolerance	Number / km	% by Number	Kg/km	% by Biomass	No. of Samples
40	010	Golden Redhorse	<i>Moxostoma erythrurum</i>	M	445	18.7	298.3	36.44	7
77	004	Smallmouth Bass	<i>Micropterus dolomieu</i>	M	224	10.26	65.2	7.96	7
40	015	Northern Hog Sucker	<i>Hypentelium nigricans</i>	M	221	10.03	73.7	9.00	6
43	043	Bluntnose Minnow	<i>Pimephales notatus</i>	T	162	8.6	1.1	0.14	7
43	032	Spotfin Shiner	<i>Cyprinella spiloptera</i>		175	7.84	1.5	0.18	7
43	021	Silver Shiner	<i>Notropis photogenis</i>	I	156	6.64	1.6	0.19	7
77	009	Bluegill Sunfish	<i>Lepomis macrochirus</i>	P	111	5.35	2.5	0.30	7
77	008	Green Sunfish	<i>Lepomis cyanellus</i>	T	116	4.98	1.3	0.16	6
43	044	Central Stoneroller	<i>Campostoma anomalum</i>		86	3.62	0.8	0.09	5
40	009	Black Redhorse	<i>Moxostoma duquesnei</i>	I	63	3.32	76.7	9.37	5
43	034	Sand Shiner	<i>Miniellus stramineus</i>	M	58	3.02	0.3	0.04	4
43	001	Common Carp	<i>Cyprinus carpio</i>	T	61	2.49	134.8	16.46	6
47	002	Channel Catfish	<i>Ictalurus punctatus</i>		54	2.26	91.8	11.21	5
77	003	Rock Bass	<i>Ambloplites rupestris</i>		41	2.04	4.0	0.49	6
80	016	Banded Darter	<i>Etheostoma zonale</i>	I	31	1.58	0.0	0.01	5
80	011	Logperch	<i>Percina caprodes</i>	M	28	1.13	0.4	0.05	6
80	019	Bluebreast Darter	<i>Nothonotus camurus</i>	R	23	0.9	0.1	0.01	4
77	011	Longear Sunfish	<i>Lepomis megalotis</i>	M	23	0.9	0.6	0.07	4
40	005	Quillback Carpsucker	<i>Carpionodes cyprinus</i>		22	0.83	22.2	2.71	4
80	015	Greenside Darter	<i>Etheostoma blennioides</i>	M	12	0.68	0.0	0.00	3
80	022	Rainbow Darter	<i>Etheostoma caeruleum</i>	M	10	0.68	0.0	0.00	3
40	008	Silver Redhorse	<i>Moxostoma anisurum</i>	M	17	0.68	33.4	4.08	3
80	024	Fantail Darter	<i>Etheostoma flabellare</i>		10	0.53	0.0	0.00	4
20	003	Gizzard Shad	<i>Dorosoma cepedianum</i>		12	0.45	0.8	0.10	3
47	008	Stonecat Madtom	<i>Noturus flavus</i>	I	10	0.45	0.3	0.03	3
77	015	Green X Bluegill Sunfish	HYBRID		8	0.38	0.5	0.06	4
80	014	Johnny Darter	<i>Etheostoma nigrum</i>		7	0.38	0.0	0.00	4
70	001	Brook Silverside	<i>Labidesthes sicculus</i>	M	7	0.3	0.0	0.00	3
77	006	Largemouth Bass	<i>Micropterus nigricans</i>		8	0.3	0.1	0.01	3
74	005	Striped Bass X White Bass	HYBRID		6	0.23	0.1	0.01	1
47	007	Flathead Catfish	<i>Pylodictis olivaris</i>		3	0.15	6.2	0.76	2

Appendix Table B-7. continued.									
77	013	Pumpkinseed Sunfish	<i>Lepomis gibbosus</i>	P	3	0.15	0.1	0.01	2
47	012	Brindled Madtom	<i>Noturus miurus</i>	I	1	0.08	0.0	0.00	1
74	001	White Bass	<i>Morone chrysops</i>		2	0.08	0.3	0.03	1
		30 native species, 1 non-native species, 2 hybrids							

Appendix Table B-8. Grand totals for fish species sampled in the Olentangy River by MBI downstream Dodridge Dam in 2022.

Family Code	Species Code	Common Name	Latin Name	Ohio Tolerance	Number / km	% by Number	Kg/km	% by Biomass	No. of Samples
40	010	Golden Redhorse	<i>Moxostoma erythrurum</i>	M	198	12.26	128.55	21.73	4
40	015	Northern Hog Sucker	<i>Hypentelium nigricans</i>	M	155	9.36	23.67	4.00	4
43	015	Suckermouth Minnow	<i>Phenacobius mirabilis</i>		88	8.92	1.16	0.20	3
43	044	Central Stoneroller	<i>Campostoma anomalum</i>		99	7.80	0.96	0.16	4
77	008	Green Sunfish	<i>Lepomis cyanellus</i>	T	117	6.69	1.05	0.18	4
43	032	Spotfin Shiner	<i>Cyprinella spiloptera</i>		97	5.80	0.59	0.10	4
43	021	Silver Shiner	<i>Notropis photogenis</i>	I	82	4.57	0.33	0.06	3
77	009	Bluegill Sunfish	<i>Lepomis macrochirus</i>	P	75	4.24	1.73	0.29	4
47	002	Channel Catfish	<i>Ictalurus punctatus</i>		75	4.24	79.20	13.39	4
80	016	Banded Darter	<i>Etheostoma zonale</i>	I	37	3.23	0.09	0.01	4
80	011	Logperch	<i>Percina caprodes</i>	M	51	3.12	0.75	0.13	4
43	001	Common Carp	<i>Cyprinus carpio</i>	T	48	2.90	121.74	20.58	4
40	009	Black Redhorse	<i>Moxostoma duquesnei</i>	I	43	2.79	48.56	8.21	4
20	003	Gizzard Shad	<i>Dorosoma cepedianum</i>		49	2.79	5.87	0.99	4
43	034	Sand Shiner	<i>Miniellus stramineus</i>	M	36	2.79	0.16	0.03	4
77	004	Smallmouth Bass	<i>Micropterus dolomieu</i>	M	43	2.45	10.61	1.79	4
40	005	Quillback Carpsucker	<i>Carpiodes cyprinus</i>		41	2.34	27.97	4.73	4
43	043	Bluntnose Minnow	<i>Pimephales notatus</i>	T	28	1.67	0.10	0.02	4
77	006	Largemouth Bass	<i>Micropterus nigricans</i>		21	1.34	0.16	0.03	4
40	013	River Redhorse	<i>Moxostoma carinatum</i>	I	21	1.23	57.53	9.72	4
40	008	Silver Redhorse	<i>Moxostoma anisurum</i>	M	17	1.11	42.06	7.11	3
80	022	Rainbow Darter	<i>Etheostoma caeruleum</i>	M	10	1.00	0.04	0.01	2
80	019	Bluebreast Darter	<i>Nothonotus camurus</i>	R	13	0.89	0.04	0.01	4
80	026	Sauger X Walleye	HYBRID		16	0.89	10.00	1.69	3
80	024	Fantail Darter	<i>Etheostoma flabellare</i>		7	0.67	0.02	0.00	2
77	011	Longear Sunfish	<i>Lepomis megalotis</i>	M	10	0.56	0.20	0.03	2
43	005	River Chub	<i>Nocomis micropogon</i>	I	9	0.56	0.08	0.01	3
40	004	Smallmouth Buffalo	<i>Ictiobus bubalus</i>		10	0.56	23.30	3.94	2
43	022	Rosyface Shiner	<i>Notropis rubellus</i>	I	6	0.45	0.03	0.01	3

Appendix Table B-8. continued.

47	008	Stonecat Madtom	<i>Noturus flavus</i>	I	8	0.45	0.20	0.03	3
80	014	Johnny Darter	<i>Etheostoma nigrum</i>		4	0.33	0.01	0.00	2
77	010	Orangespotted Sunfish	<i>Lepomis humilis</i>		6	0.33	0.05	0.01	1
77	003	Rock Bass	<i>Ambloplites rupestris</i>		6	0.33	0.20	0.03	2
77	002	Black Crappie	<i>Pomoxis nigromaculatus</i>		4	0.22	0.13	0.02	2
70	001	Brook Silverside	<i>Labidesthes sicculus</i>	M	4	0.22	0.01	0.00	1
47	007	Flathead Catfish	<i>Pylodictis olivaris</i>		4	0.22	3.30	0.56	2
80	015	Greenside Darter	<i>Etheostoma blennioides</i>	M	3	0.22	0.01	0.00	2
74	005	Striped Bass X White Bass	HYBRID		4	0.22	1.05	0.18	2
43	013	Creek Chub	<i>Semotilus atromaculatus</i>	T	1	0.11	0.01	0.00	1
77	015	Green X Bluegill Sunfish	HYBRID		1	0.11	0.01	0.00	1
		36 native species, 1 non-native species, 3 hybrids							

Appendix Table B-- . Midwest Biodiversity Institute

Fish Species List

Site ID: OLN05 River: 02-400 Olentangy River RM: 14.90 Date: 07/15/2022

Time Fished: 3341 Distance: 0.500 Drainge (sq mi): 482.0 Depth: 0

Location: dst. OH-750 Lat: 40.15578 Long: -83.04527

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		1	2.0	0.34	320	0.24	160.0
40-005	Quillback Carpsucker	O		M	C	3	6.0	1.02	4800	3.59	800.0
40-008	Silver Redhorse	I	M	S	R	2	4.0	0.68	9400	7.03	2350.0
40-009	Black Redhorse	I	I	S	R	12	24.0	4.08	13000	9.72	541.6
40-010	Golden Redhorse	I	M	S	R	40	80.0	13.61	40400	30.21	505.0
40-015	Northern Hog Sucker	I	M	S	R	32	64.0	10.88	15220	11.38	237.8
43-001	Common Carp	O	T	M	G	10	20.0	3.40	30400	22.73	1520.0
43-021	Silver Shiner	I	I	S	N	10	20.0	3.40	220	0.16	11.0
43-032	Spotfin Shiner	I		M	N	47	94.0	15.99	700	0.52	7.4
43-034	Sand Shiner	I	I	M	N	9	18.0	3.06	80	0.06	4.4
43-043	Bluntnose Minnow	O	T	C	N	37	74.0	12.59	260	0.19	3.5
43-044	Central Stoneroller	H		N	N	15	30.0	5.10	300	0.22	10.0
47-002	Channel Catfish			C	F	7	14.0	2.38	10200	7.63	728.5
47-008	Stonecat Madtom	I	I	C		1	2.0	0.34	80	0.06	40.0
74-001	White Bass	P		M	F	1	2.0	0.34	280	0.21	140.0
77-003	Rock Bass	C		C	S	7	14.0	2.38	300	0.22	21.4
77-004	Smallmouth Bass	C	M	C	F	32	64.0	10.88	7140	5.34	111.5
77-008	Green Sunfish	I	T	C	S	2	4.0	0.68	50	0.04	12.5
77-009	Bluegill Sunfish	I	P	C	S	12	24.0	4.08	200	0.15	8.3
77-011	Longear Sunfish	I	M	C	S	4	8.0	1.36	220	0.16	27.5
80-011	Logperch	I	M	S	D	3	6.0	1.02	120	0.09	20.0
80-016	Banded Darter	I	I	S	D	2	4.0	0.68	6	0.00	1.5
80-019	Bluebreast Darter	I	R	S	D	3	6.0	1.02	20	0.01	3.3
80-022	Rainbow Darter	I	M	S	D	1	2.0	0.34	4	0.00	2.0
80-024	Fantail Darter	I		C	D	1	2.0	0.34	2	0.00	1.0

No Species: 25 **Nat. Species:** 24 **Hybrids:** 0 **Total Counted:** 294 **Total Rel. Wt. :** 133722

IBI: 48.0 **MIwb:** 9.9

Appendix Table B-- . Midwest Biodiversity Institute

Fish Species List

Site ID: OLN07 River: 02-400 Olentangy River RM: 12.90 Date: 08/19/2022

Time Fished: 2206 Distance: 0.300 Drainge (sq mi): 489.0 Depth: 0

Location: dst. Olentangy WRF Lat: 40.13012 Long: -83.03478

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-008	Silver Redhorse	I	M	S	R	1	1.0	0.39	0	0.00	0.0
40-009	Black Redhorse	I	I	S	R	5	5.0	1.96	3500	9.28	700.0
40-010	Golden Redhorse	I	M	S	R	19	19.0	7.45	10150	26.93	534.2
40-015	Northern Hog Sucker	I	M	S	R	29	29.0	11.37	7140	18.94	246.2
43-001	Common Carp	O	T	M	G	3	3.0	1.18	0	0.00	0.0
43-021	Silver Shiner	I	I	S	N	8	8.0	3.14	80	0.21	10.0
43-032	Spotfin Shiner	I		M	N	14	14.0	5.49	100	0.27	7.1
43-034	Sand Shiner	I	I	M	N	20	20.0	7.84	55	0.15	2.7
43-043	Bluntnose Minnow	O	T	C	N	57	57.0	22.35	220	0.58	3.8
43-044	Central Stoneroller	H		N	N	9	9.0	3.53	40	0.11	4.4
47-002	Channel Catfish			C	F	4	4.0	1.57	9050	24.01	2262.5
47-007	Flathead Catfish	P		C	F	1	1.0	0.39	1450	3.85	1450.0
47-008	Stonecat Madtom	I	I	C		2	2.0	0.78	50	0.13	25.0
47-012	Brindled Madtom	I	I	C		1	1.0	0.39	10	0.03	10.0
77-003	Rock Bass	C		C	S	7	7.0	2.75	300	0.80	42.8
77-004	Smallmouth Bass	C	M	C	F	29	29.0	11.37	5040	13.37	173.7
77-008	Green Sunfish	I	T	C	S	9	9.0	3.53	90	0.24	10.0
77-009	Bluegill Sunfish	I	P	C	S	16	16.0	6.27	240	0.64	15.0
77-011	Longear Sunfish	I	M	C	S	1	1.0	0.39	15	0.04	15.0
77-015	Green X Bluegill Sunfish					1	1.0	0.39	110	0.29	110.0
80-011	Logperch	I	M	S	D	1	1.0	0.39	40	0.11	40.0
80-014	Johnny Darter	I		C	D	2	2.0	0.78	2	0.01	1.0
80-015	Greenside Darter	I	M	S	D	5	5.0	1.96	5	0.01	1.0
80-016	Banded Darter	I	I	S	D	7	7.0	2.75	5	0.01	0.7
80-019	Bluebreast Darter	I	R	S	D	1	1.0	0.39	2	0.01	2.0
80-022	Rainbow Darter	I	M	S	D	2	2.0	0.78	2	0.01	1.0
80-024	Fantail Darter	I		C	D	1	1.0	0.39	1	0.00	1.0

No Species: 26 **Nat. Species:** 25 **Hybrids:** 1 **Total Counted:** 255 **Total Rel. Wt. :** 37697

IBI: 46.0 **MIwb:** 8.9

Appendix Table B-- . Midwest Biodiversity Institute

Fish Species List

Site ID: OLN08 River: 02-400 Olentangy River RM: 12.30 Date: 08/19/2022

Time Fished: 1828 Distance: 0.300 Drainge (sq mi): 490.0 Depth: 0

Location: Olentangy R. @Worthington Ust. I-270 N. Lat: 40.12185 Long: -83.03221

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-009	Black Redhorse	I	I	S	R	20	20.0	11.05	12800	29.02	640.0
40-010	Golden Redhorse	I	M	S	R	32	32.0	17.68	17350	39.34	542.1
40-015	Northern Hog Sucker	I	M	S	R	16	16.0	8.84	5360	12.15	335.0
43-001	Common Carp	O	T	M	G	2	2.0	1.10	0	0.00	0.0
43-021	Silver Shiner	I	I	S	N	12	12.0	6.63	55	0.12	4.5
43-032	Spotfin Shiner	I		M	N	19	19.0	10.50	73	0.17	3.8
43-034	Sand Shiner	I	I	M	N	2	2.0	1.10	4	0.01	2.0
43-043	Bluntnose Minnow	O	T	C	N	9	9.0	4.97	25	0.06	2.7
43-044	Central Stoneroller	H		N	N	1	1.0	0.55	3	0.01	3.0
47-002	Channel Catfish			C	F	2	2.0	1.10	5100	11.56	2550.0
70-001	Brook Silverside	I	M	M		1	1.0	0.55	1	0.00	1.0
77-003	Rock Bass	C		C	S	6	6.0	3.31	560	1.27	93.3
77-004	Smallmouth Bass	C	M	C	F	19	19.0	10.50	2480	5.62	130.5
77-008	Green Sunfish	I	T	C	S	7	7.0	3.87	40	0.09	5.7
77-009	Bluegill Sunfish	I	P	C	S	15	15.0	8.29	200	0.45	13.3
77-013	Pumpkinseed Sunfish	I	P	C	S	1	1.0	0.55	30	0.07	30.0
77-015	Green X Bluegill Sunfish					1	1.0	0.55	5	0.01	5.0
80-011	Logperch	I	M	S	D	1	1.0	0.55	0	0.00	0.0
80-014	Johnny Darter	I		C	D	1	1.0	0.55	1	0.00	1.0
80-015	Greenside Darter	I	M	S	D	1	1.0	0.55	2	0.00	2.0
80-016	Banded Darter	I	I	S	D	4	4.0	2.21	3	0.01	0.7
80-022	Rainbow Darter	I	M	S	D	6	6.0	3.31	5	0.01	0.8
80-024	Fantail Darter	I		C	D	3	3.0	1.66	3	0.01	1.0

No Species: 22 **Nat. Species:** 21 **Hybrids:** 1 **Total Counted:** 181 **Total Rel. Wt. :** 44100

IBI: 46.0 **MIwb:** 8.5

Appendix Table B-- . Midwest Biodiversity Institute

Fish Species List

Site ID: OLN09 River: 02-400 Olentangy River RM: 8.50 Date: 08/30/2022

Time Fished: 2718 Distance: 0.500 Drainge (sq mi): 510.0 Depth: 0

Location: dst. Broad Meadows Dam Lat: 40.07425 Long: -83.03503

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-005	Quillback Carpsucker	O		M	C	5	10.0	3.42	10500	12.97	1050.0
40-008	Silver Redhorse	I	M	S	R	6	12.0	4.11	24000	29.65	2000.0
40-009	Black Redhorse	I	I	S	R	1	2.0	0.68	1200	1.48	600.0
40-010	Golden Redhorse	I	M	S	R	23	46.0	15.75	24000	29.65	521.7
40-015	Northern Hog Sucker	I	M	S	R	24	48.0	16.44	9280	11.47	193.3
43-021	Silver Shiner	I	I	S	N	21	42.0	14.38	320	0.40	7.6
43-032	Spotfin Shiner	I		M	N	10	20.0	6.85	100	0.12	5.0
43-043	Bluntnose Minnow	O	T	C	N	3	6.0	2.05	10	0.01	1.6
43-044	Central Stoneroller	H		N	N	8	16.0	5.48	60	0.07	3.7
47-002	Channel Catfish			C	F	2	4.0	1.37	1000	1.24	250.0
47-007	Flathead Catfish	P		C	F	1	2.0	0.68	1400	1.73	700.0
47-008	Stonecat Madtom	I	I	C		3	6.0	2.05	20	0.02	3.3
70-001	Brook Silverside	I	M	M		1	2.0	0.68	4	0.00	2.0
77-003	Rock Bass	C		C	S	1	2.0	0.68	80	0.10	40.0
77-004	Smallmouth Bass	C	M	C	F	14	28.0	9.59	8620	10.65	307.8
77-006	Largemouth Bass	C		C	F	2	4.0	1.37	20	0.02	5.0
77-009	Bluegill Sunfish	I	P	C	S	6	12.0	4.11	220	0.27	18.3
77-015	Green X Bluegill Sunfish					2	4.0	1.37	30	0.04	7.5
80-011	Logperch	I	M	S	D	5	10.0	3.42	50	0.06	5.0
80-016	Banded Darter	I	I	S	D	1	2.0	0.68	2	0.00	1.0
80-019	Bluebreast Darter	I	R	S	D	7	14.0	4.79	20	0.02	1.4

No Species: 20 **Nat. Species:** 20 **Hybrids:** 1 **Total Counted:** 146 **Total Rel. Wt. :** 80936
IBI: 50.0 **MIwb:** 9.3

Appendix Table B-- . Midwest Biodiversity Institute

Fish Species List

Site ID: OLN10 River: 02-400 Olentangy River RM: 7.10 Date: 08/30/2022

Time Fished: 1741 Distance: 0.500 Drainge (sq mi): 516.0 Depth: 0

Location: ust. Henderson Rd. Lat: 40.05578 Long: -83.02865

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-005	Quillback Carpsucker	O		M	C	1	2.0	0.44	2200	1.42	1100.0
40-009	Black Redhorse	I	I	S	R	6	12.0	2.63	8200	5.30	683.3
40-010	Golden Redhorse	I	M	S	R	65	130.0	28.51	72400	46.77	556.9
40-015	Northern Hog Sucker	I	M	S	R	31	62.0	13.60	6140	3.97	99.0
43-001	Common Carp	O	T	M	G	6	12.0	2.63	25500	16.47	2125.0
43-021	Silver Shiner	I	I	S	N	26	52.0	11.40	400	0.26	7.6
43-032	Spotfin Shiner	I		M	N	10	20.0	4.39	90	0.06	4.5
43-034	Sand Shiner	I	I	M	N	9	18.0	3.95	40	0.03	2.2
43-043	Bluntnose Minnow	O	T	C	N	1	2.0	0.44	10	0.01	5.0
43-044	Central Stoneroller	H		N	N	15	30.0	6.58	260	0.17	8.6
47-002	Channel Catfish			C	F	15	30.0	6.58	33420	21.59	1114.0
77-003	Rock Bass	C		C	S	4	8.0	1.75	560	0.36	70.0
77-004	Smallmouth Bass	C	M	C	F	14	28.0	6.14	5230	3.38	186.7
77-008	Green Sunfish	I	T	C	S	1	2.0	0.44	10	0.01	5.0
77-009	Bluegill Sunfish	I	P	C	S	6	12.0	2.63	160	0.10	13.3
77-015	Green X Bluegill Sunfish					1	2.0	0.44	60	0.04	30.0
80-011	Logperch	I	M	S	D	3	6.0	1.32	80	0.05	13.3
80-014	Johnny Darter	I		C	D	1	2.0	0.44	2	0.00	1.0
80-015	Greenside Darter	I	M	S	D	3	6.0	1.32	10	0.01	1.6
80-016	Banded Darter	I	I	S	D	7	14.0	3.07	10	0.01	0.7
80-019	Bluebreast Darter	I	R	S	D	1	2.0	0.44	6	0.00	3.0
80-024	Fantail Darter	I		C	D	2	4.0	0.88	6	0.00	1.5

No Species: 21 **Nat. Species:** 20 **Hybrids:** 1 **Total Counted:** 228 **Total Rel. Wt. :** 154794

IBI: 50.0 **MIwb:** 9.4

Appendix Table B-- . Midwest Biodiversity Institute

Fish Species List

Site ID: OLN11 River: 02-400 Olentangy River RM: 5.82 Date: 08/30/2022

Time Fished: 2039 Distance: 0.500 Drainge (sq mi): 524.0 Depth: 0

Location: ust. W. North Broadway, dst. Adena Brook Lat: 40.03824 Long: -83.02899

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		1	2.0	1.18	400	0.54	200.0
40-005	Quillback Carpsucker	O		M	C	2	4.0	2.35	4700	6.32	1175.0
40-010	Golden Redhorse	I	M	S	R	30	60.0	35.29	35700	48.03	595.0
43-001	Common Carp	O	T	M	G	8	16.0	9.41	23800	32.02	1487.5
43-021	Silver Shiner	I	I	S	N	3	6.0	3.53	40	0.05	6.6
43-032	Spotfin Shiner	I		M	N	2	4.0	2.35	20	0.03	5.0
43-043	Bluntnose Minnow	O	T	C	N	1	2.0	1.18	6	0.01	3.0
70-001	Brook Silverside	I	M	M		2	4.0	2.35	6	0.01	1.5
74-005	Striped Bass X White Bass				E	3	6.0	3.53	80	0.11	13.3
77-004	Smallmouth Bass	C	M	C	F	8	16.0	9.41	9100	12.24	568.7
77-006	Largemouth Bass	C		C	F	1	2.0	1.18	10	0.01	5.0
77-008	Green Sunfish	I	T	C	S	20	40.0	23.53	320	0.43	8.0
77-009	Bluegill Sunfish	I	P	C	S	3	6.0	3.53	120	0.16	20.0
77-011	Longear Sunfish	I	M	C	S	1	2.0	1.18	30	0.04	15.0

No Species: 13 **Nat. Species:** 12 **Hybrids:** 1 **Total Counted:** 85 **Total Rel. Wt. :** 74332
IBI: 32.0 **MIwb:** 7.3

Appendix Table B-- . Midwest Biodiversity Institute

Fish Species List

Site ID: OLN12 River: 02-400 Olentangy River RM: 4.45 Date: 08/29/2022

Time Fished: 2224 Distance: 0.500 Drainge (sq mi): 529.0 Depth: 0

Location: ust. Dodridge Dam, adj. OSU wetlands Lat: 40.02187 Long: -83.01910

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		4	8.0	2.92	100	0.19	12.5
40-010	Golden Redhorse	I	M	S	R	39	78.0	28.47	31000	57.67	397.4
40-015	Northern Hog Sucker	I	M	S	R	1	2.0	0.73	1400	2.60	700.0
43-001	Common Carp	O	T	M	G	4	8.0	2.92	10380	19.31	1297.5
43-021	Silver Shiner	I	I	S	N	8	16.0	5.84	120	0.22	7.5
43-032	Spotfin Shiner	I		M	N	2	4.0	1.46	10	0.02	2.5
43-043	Bluntnose Minnow	O	T	C	N	6	12.0	4.38	20	0.04	1.6
77-003	Rock Bass	C		C	S	2	4.0	1.46	220	0.41	55.0
77-004	Smallmouth Bass	C	M	C	F	20	40.0	14.60	9400	17.49	235.0
77-006	Largemouth Bass	C		C	F	1	2.0	0.73	20	0.04	10.0
77-008	Green Sunfish	I	T	C	S	27	54.0	19.71	500	0.93	9.2
77-009	Bluegill Sunfish	I	P	C	S	13	26.0	9.49	300	0.56	11.5
77-011	Longear Sunfish	I	M	C	S	6	12.0	4.38	250	0.47	20.8
77-013	Pumpkinseed Sunfish	I	P	C	S	1	2.0	0.73	0	0.00	0.0
80-011	Logperch	I	M	S	D	2	4.0	1.46	30	0.06	7.5
80-014	Johnny Darter	I		C	D	1	2.0	0.73	2	0.00	1.0

No Species: 16 **Nat. Species:** 15 **Hybrids:** 0 **Total Counted:** 137 **Total Rel. Wt. :** 53752

IBI: 38.0 **MIwb:** 7.9

Appendix Table B-- . Midwest Biodiversity Institute

Fish Species List

Site ID: OLN01 River: 02-400 Olentangy River RM: 3.95 Date: 09/02/2022

Time Fished: 2322 Distance: 0.500 Drainge (sq mi): 531.0 Depth: 0

Location: dst. Dodridge dam Lat: 40.01656 Long: -83.01652

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		3	6.0	1.06	640	0.44	106.6
40-005	Quillback Carpsucker	O		M	C	5	10.0	1.76	5700	3.96	570.0
40-008	Silver Redhorse	I	M	S	R	2	4.0	0.70	5200	3.62	1300.0
40-009	Black Redhorse	I	I	S	R	11	22.0	3.87	12600	8.76	572.7
40-010	Golden Redhorse	I	M	S	R	38	76.0	13.38	31220	21.71	410.7
40-013	River Redhorse	I	I	S	R	5	10.0	1.76	25700	17.87	2570.0
40-015	Northern Hog Sucker	I	M	S	R	23	46.0	8.10	3400	2.36	73.9
43-001	Common Carp	O	T	M	G	12	24.0	4.23	25300	17.59	1054.1
43-015	Suckermouth Minnow	I		S	N	2	4.0	0.70	20	0.01	5.0
43-021	Silver Shiner	I	I	S	N	25	50.0	8.80	220	0.15	4.4
43-032	Spotfin Shiner	I		M	N	23	46.0	8.10	220	0.15	4.7
43-034	Sand Shiner	I	I	M	N	3	6.0	1.06	12	0.01	2.0
43-043	Bluntnose Minnow	O	T	C	N	6	12.0	2.11	40	0.03	3.3
43-044	Central Stoneroller	H		N	N	7	14.0	2.46	60	0.04	4.2
47-002	Channel Catfish			C	F	12	24.0	4.23	24100	16.76	1004.1
47-007	Flathead Catfish	P		C	F	1	2.0	0.35	3300	2.29	1650.0
47-008	Stonecat Madtom	I	I	C		1	2.0	0.35	50	0.03	25.0
70-001	Brook Silverside	I	M	M		2	4.0	0.70	6	0.00	1.5
74-005	Striped Bass X White Bass				E	1	2.0	0.35	50	0.03	25.0
77-002	Black Crappie	I		C	S	1	2.0	0.35	70	0.05	35.0
77-003	Rock Bass	C		C	S	2	4.0	0.70	100	0.07	25.0
77-004	Smallmouth Bass	C	M	C	F	9	18.0	3.17	1080	0.75	60.0
77-006	Largemouth Bass	C		C	F	3	6.0	1.06	20	0.01	3.3
77-008	Green Sunfish	I	T	C	S	45	90.0	15.85	380	0.26	4.2
77-009	Bluegill Sunfish	I	P	C	S	13	26.0	4.58	700	0.49	26.9
77-010	Orangespotted Sunfish	I		C	S	3	6.0	1.06	50	0.03	8.3
77-011	Longear Sunfish	I	M	C	S	4	8.0	1.41	180	0.13	22.5
80-011	Logperch	I	M	S	D	9	18.0	3.17	180	0.13	10.0
80-014	Johnny Darter	I		C	D	1	2.0	0.35	2	0.00	1.0
80-015	Greenside Darter	I	M	S	D	1	2.0	0.35	4	0.00	2.0
80-016	Banded Darter	I	I	S	D	5	10.0	1.76	12	0.01	1.2
80-019	Bluebreast Darter	I	R	S	D	2	4.0	0.70	10	0.01	2.5
80-022	Rainbow Darter	I	M	S	D	1	2.0	0.35	4	0.00	2.0
80-026	Sauger X Walleye	P			E	3	6.0	1.06	3200	2.22	533.3

No Species: 32 **Nat. Species:** 31 **Hybrids:** 2 **Total Counted:** 284 **Total Rel. Wt. :** 143830

IBI: 48.0 **MIwb:** 10.2

Appendix Table B-- . Midwest Biodiversity Institute

Fish Species List

Site ID: OLN02 River: 02-400 Olentangy River RM: 2.00 Date: 08/15/2022

Time Fished: 2499 Distance: 0.500 Drainge (sq mi): 537.0 Depth: 0

Location: ust. 5th. Ave. Lat: 39.99339 Long: -83.02396

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		15	30.0	9.43	3050	3.64	101.6
40-004	Smallmouth Buffalo	I		M	C	1	2.0	0.63	6900	8.24	3450.0
40-005	Quillback Carpsucker	O		M	C	2	4.0	1.26	2400	2.87	600.0
40-009	Black Redhorse	I	I	S	R	5	10.0	3.14	7000	8.36	700.0
40-010	Golden Redhorse	I	M	S	R	20	40.0	12.58	19100	22.80	477.5
40-013	River Redhorse	I	I	S	R	4	8.0	2.52	18700	22.33	2337.5
40-015	Northern Hog Sucker	I	M	S	R	23	46.0	14.47	4740	5.66	103.0
43-001	Common Carp	O	T	M	G	2	4.0	1.26	5700	6.81	1425.0
43-005	River Chub	I	I	N	N	3	6.0	1.89	70	0.08	11.6
43-021	Silver Shiner	I	I	S	N	14	28.0	8.81	100	0.12	3.5
43-022	Rosyface Shiner	I	I	S	N	1	2.0	0.63	4	0.00	2.0
43-032	Spotfin Shiner	I		M	N	13	26.0	8.18	120	0.14	4.6
43-034	Sand Shiner	I	I	M	N	1	2.0	0.63	4	0.00	2.0
43-043	Bluntnose Minnow	O	T	C	N	3	6.0	1.89	20	0.02	3.3
43-044	Central Stoneroller	H		N	N	8	16.0	5.03	60	0.07	3.7
47-002	Channel Catfish			C	F	5	10.0	3.14	8204	9.79	820.4
47-007	Flathead Catfish	P		C	F	1	2.0	0.63	2	0.00	1.0
47-008	Stonecat Madtom	I	I	C		1	2.0	0.63	10	0.01	5.0
77-004	Smallmouth Bass	C	M	C	F	7	14.0	4.40	3440	4.11	245.7
77-006	Largemouth Bass	C		C	F	3	6.0	1.89	30	0.04	5.0
77-008	Green Sunfish	I	T	C	S	6	12.0	3.77	60	0.07	5.0
77-009	Bluegill Sunfish	I	P	C	S	5	10.0	3.14	240	0.29	24.0
77-011	Longear Sunfish	I	M	C	S	1	2.0	0.63	20	0.02	10.0
80-011	Logperch	I	M	S	D	10	20.0	6.29	270	0.32	13.5
80-016	Banded Darter	I	I	S	D	1	2.0	0.63	4	0.00	2.0
80-019	Bluebreast Darter	I	R	S	D	2	4.0	1.26	12	0.01	3.0
80-026	Sauger X Walleye	P			E	2	4.0	1.26	3500	4.18	875.0

No Species: 26 **Nat. Species:** 25 **Hybrids:** 1 **Total Counted:** 159 **Total Rel. Wt. :** 83760

IBI: 48.0 **MIwb:** 9.9

Appendix Table B-- . Midwest Biodiversity Institute

Fish Species List

Site ID: OLN03 River: 02-400 Olentangy River RM: 1.80 Date: 08/15/2022

Time Fished: 2422 Distance: 0.500 Drainge (sq mi): 537.0 Depth: 0

Location: dst. 5th. Ave., ust. 3rd. Ave. Lat: 39.98742 Long: -83.02436

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		6	12.0	2.90	1910	1.08	159.1
40-004	Smallmouth Buffalo	I		M	C	4	8.0	1.93	16400	9.24	2050.0
40-005	Quillback Carpsucker	O		M	C	13	26.0	6.28	16200	9.12	623.0
40-008	Silver Redhorse	I	M	S	R	5	10.0	2.42	18200	10.25	1820.0
40-009	Black Redhorse	I	I	S	R	2	4.0	0.97	1800	1.01	450.0
40-010	Golden Redhorse	I	M	S	R	30	60.0	14.49	33400	18.81	556.6
40-013	River Redhorse	I	I	S	R	1	2.0	0.48	5800	3.27	2900.0
40-015	Northern Hog Sucker	I	M	S	R	25	50.0	12.08	7460	4.20	149.2
43-001	Common Carp	O	T	M	G	8	16.0	3.86	23400	13.18	1462.5
43-005	River Chub	I	I	N	N	1	2.0	0.48	8	0.00	4.0
43-015	Suckermouth Minnow	I		S	N	6	12.0	2.90	100	0.06	8.3
43-021	Silver Shiner	I	I	S	N	2	4.0	0.97	10	0.01	2.5
43-022	Rosyface Shiner	I	I	S	N	1	2.0	0.48	2	0.00	1.0
43-032	Spotfin Shiner	I		M	N	9	18.0	4.35	86	0.05	4.7
43-034	Sand Shiner	I	I	M	N	7	14.0	3.38	40	0.02	2.8
43-043	Bluntnose Minnow	O	T	C	N	4	8.0	1.93	30	0.02	3.7
43-044	Central Stoneroller	H		N	N	14	28.0	6.76	140	0.08	5.0
47-002	Channel Catfish			C	F	20	40.0	9.66	43400	24.44	1085.0
47-008	Stonecat Madtom	I	I	C		2	4.0	0.97	140	0.08	35.0
74-005	Striped Bass X White Bass				E	1	2.0	0.48	1000	0.56	500.0
77-002	Black Crappie	I		C	S	1	2.0	0.48	60	0.03	30.0
77-003	Rock Bass	C		C	S	1	2.0	0.48	100	0.06	50.0
77-004	Smallmouth Bass	C	M	C	F	5	10.0	2.42	3640	2.05	364.0
77-006	Largemouth Bass	C		C	F	3	6.0	1.45	30	0.02	5.0
77-008	Green Sunfish	I	T	C	S	6	12.0	2.90	280	0.16	23.3
77-009	Bluegill Sunfish	I	P	C	S	19	38.0	9.18	530	0.30	13.9
80-011	Logperch	I	M	S	D	4	8.0	1.93	100	0.06	12.5
80-016	Banded Darter	I	I	S	D	2	4.0	0.97	4	0.00	1.0
80-019	Bluebreast Darter	I	R	S	D	1	2.0	0.48	6	0.00	3.0
80-024	Fantail Darter	I		C	D	1	2.0	0.48	4	0.00	2.0
80-026	Sauger X Walleye	P			E	3	6.0	1.45	3300	1.86	550.0

No Species: 29 **Nat. Species:** 28 **Hybrids:** 2 **Total Counted:** 207 **Total Rel. Wt. :** 177580

IBI: 48.0 **MIwb:** 10.4

Appendix Table B-- . Midwest Biodiversity Institute

Fish Species List

Site ID: OLN04 River: 02-400 Olentangy River RM: 0.20 Date: 08/19/2022

Time Fished: 2078 Distance: 0.300 Drainge (sq mi): 543.0 Depth: 0

Location: ust. I-670 bridge Lat: 39.96638 Long: -83.01866

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		1	1.0	0.40	80	0.18	80.0
40-005	Quillback Carpsucker	O		M	C	1	1.0	0.40	1100	2.49	1100.0
40-008	Silver Redhorse	I	M	S	R	3	3.0	1.21	5600	12.70	1866.6
40-009	Black Redhorse	I	I	S	R	7	7.0	2.83	8150	18.48	1164.2
40-010	Golden Redhorse	I	M	S	R	22	22.0	8.91	13450	30.50	611.3
40-013	River Redhorse	I	I	S	R	1	1.0	0.40	2200	4.99	2200.0
40-015	Northern Hog Sucker	I	M	S	R	13	13.0	5.26	2420	5.49	186.1
43-001	Common Carp	O	T	M	G	4	4.0	1.62	8400	19.05	2100.0
43-005	River Chub	I	I	N	N	1	1.0	0.40	2	0.00	2.0
43-013	Creek Chub	G	T	N	N	1	1.0	0.40	2	0.00	2.0
43-015	Suckermouth Minnow	I		S	N	72	72.0	29.15	300	0.68	4.1
43-022	Rosyface Shiner	I	I	S	N	2	2.0	0.81	8	0.02	4.0
43-032	Spotfin Shiner	I		M	N	7	7.0	2.83	50	0.11	7.1
43-034	Sand Shiner	I	I	M	N	14	14.0	5.67	30	0.07	2.1
43-043	Bluntnose Minnow	O	T	C	N	2	2.0	0.81	4	0.01	2.0
43-044	Central Stoneroller	H		N	N	41	41.0	16.60	210	0.48	5.1
47-002	Channel Catfish			C	F	1	1.0	0.40	1050	2.38	1050.0
77-004	Smallmouth Bass	C	M	C	F	1	1.0	0.40	735	1.67	735.0
77-006	Largemouth Bass	C		C	F	3	3.0	1.21	25	0.06	8.3
77-008	Green Sunfish	I	T	C	S	3	3.0	1.21	100	0.23	33.3
77-009	Bluegill Sunfish	I	P	C	S	1	1.0	0.40	60	0.14	60.0
77-015	Green X Bluegill Sunfish					1	1.0	0.40	20	0.05	20.0
80-011	Logperch	I	M	S	D	5	5.0	2.02	60	0.14	12.0
80-014	Johnny Darter	I		C	D	2	2.0	0.81	2	0.00	1.0
80-015	Greenside Darter	I	M	S	D	1	1.0	0.40	2	0.00	2.0
80-016	Banded Darter	I	I	S	D	21	21.0	8.50	20	0.05	0.9
80-019	Bluebreast Darter	I	R	S	D	3	3.0	1.21	5	0.01	1.6
80-022	Rainbow Darter	I	M	S	D	8	8.0	3.24	10	0.02	1.2
80-024	Fantail Darter	I		C	D	5	5.0	2.02	5	0.01	1.0

No Species: 28 **Nat. Species:** 27 **Hybrids:** 1 **Total Counted:** 247 **Total Rel. Wt. :** 44100

IBI: 52.0 **MIwb:** 8.9

APPENDIX B: OLENTANGY TRIBUTARIES FISH ASSEMBLAGE DATA 2022

B-10: Olentangy Tributaries IBI Metrics and IBI Scores 2022

B-11: Fish Species Olentangy River Tributaries (all sites combined) 2022

B-12: Olentangy Tributaries Fish Species by Site and Sample 2022

Appendix Table B-9%. Headwater IBI scores and metrics for the Olentangy River tributaries sampled by MBI in 2022.

Site ID	River Mile Type	Drainage Date	Drainage area (sq mi)	Number of						Percent of Individuals					Rel.No. minus tolerants /(0.3km)	IBI
				Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies		
<i>(02-401) - Adena Brook</i>																
Year: 2022																
ADN04	1.70 E	07/12/2022	1.80	5(3)	3(3)	1(1)	0(1)	0(1)	2(3)	97(1)	0(5)	80(1)	0(1)	0.0(5)	18(1)	26
ADN03	0.80 E	07/12/2022	2.28	3(1)	3(3)	1(1)	0(1)	0(1)	1(1)	92(1)	0(5)	81(1)	0(1)	0.0(5)	44(1)	22
ADN02	0.52 E	07/12/2022	2.66	5(3)	3(3)	1(1)	0(1)	0(1)	2(3)	78(1)	1(5)	56(1)	4(1)	0.0(5)	82(3)	28
ADN01	0.23 E	07/12/2022	2.71	10(5)	3(3)	1(1)	2(3)	2(3)	4(5)	73(1)	7(5)	57(1)	6(1)	0.0(5)	204(3)	36
<i>(02-402) - Turkey Run</i>																
Year: 2022																
TUR01	0.70 E	07/12/2022	2.09	3(1)	2(1)	1(1)	0(1)	0(1)	1(1)	100(1)	0(5)	82(1)	44(5)	0.0(5)	0(1)	24
<i>(02-403) - Rush Run</i>																
Year: 2022																
RSH01	0.24 E	07/11/2022	2.62	10(5)	3(3)	2(3)	1(1)	3(5)	4(5)	76(1)	12(3)	56(1)	12(1)	0.0(5)	152(3)	36
<i>(02-404) - Bartholomew Run</i>																
Year: 2022																
BAR01	0.20 F	07/11/2022	1.13	6(3)	2(3)	1(1)	0(1)	1(3)	3(5)	95(1)	2(5)	43(3)	5(1)	0.0(5)	22(1)	32
<i>(02-439) - Wahalla Hollow (Ravine)</i>																
Year: 2022																
WAH01	1.00 F	07/15/2022	1.13	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0.0(1)	0(1) * *	12
<i>(02-440) - Tributary to Olentangy R. (RM 7.82) (Bull Moose Run)</i>																
Year: 2022																
BMR01	0.20 F	07/11/2022	2.69	10(5)	3(3)	2(3)	2(3)	2(3)	4(5)	63(1)	1(5)	43(3)	12(1)	0.0(5)	182(3)	40
<i>(02-442) - Linworth Run</i>																
Year: 2022																
LIN01	0.80 F	07/11/2022	2.58	5(3)	3(3)	1(1)	0(1)	0(1)	2(3)	98(1)	1(5)	64(1)	0(1)	0.0(5)	14(1)	26
<i>(02-465) - Glen Echo Ravine</i>																

◆ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Appendix Table B-9. Headwater IBI scores and metrics for the Olentangy River tributaries sampled by MBI in 2022.

Site ID	River Mile Type	Drainage Date	Drainage area (sq mi)	Number of						Percent of Individuals					Rel.No. minus tolerants / (0.3km)	IBI
				Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies		
Year: 2022																
GER01	0.95 F	07/27/2022	0.59	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0.0(1)	0(1) * *	12
<i>(02-492) - Tributary to Olentangy River @ RM 8.45</i>																
Year: 2022																
TRIB01	0.10 F	07/11/2022	1.08	7(5)	3(3)	1(1)	0(1)	0(1)	2(3)	93(1)	1(5)	66(1)	7(1)	0.0(5)	38(3)	30

◆ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Appendix B- . Grand totals for fish species sampled by MBI in the nine Olentangy River tributaries during 2022.

Family Code	Species Code	Common Name	Latin Name	Ohio Tolerance	Number / km	% by Number	No. of Samples
43	013	Creek Chub	<i>Semotilus atromaculatus</i>	T	1802	48.8	6
43	011	Western Blacknose Dace	<i>Rhinichthys obtusus</i>	T	942	25.5	6
77	008	Green Sunfish	<i>Lepomis cyanellus</i>	T	444	12.0	5
43	044	Central Stoneroller	<i>Campostoma anomalum</i>		246	6.7	4
40	016	White Sucker	<i>Catostomus commersoni</i>	T	100	2.7	5
77	009	Bluegill Sunfish	<i>Lepomis macrochirus</i>	P	64	1.7	5
77	006	Largemouth Bass	<i>Micropterus nigricans</i>		46	1.2	3
80	023	Orangethroat Darter	<i>Etheostoma spectabile</i>		24	0.7	2
80	022	Rainbow Darter	<i>Etheostoma caeruleum</i>	M	14	0.4	2
40	010	Golden Redhorse	<i>Moxostoma erythrurum</i>	M	10	0.3	1
80	024	Fantail Darter	<i>Etheostoma flabellare</i>		4	0.1	2
99	999	No Fish			0	0.0	2
		11 native species, 0 non-native species, no hybrids.					

Appendix Table B-1&. Midwest Biodiversity Institute

Fish Species List

Site ID: BW06 River: 02-100 Big Walnut Creek RM: 9.80 Date: 08/09/2022

Time Fished: 2806 Distance: 0.500 Drainge (sq mi): 547.0 Depth: 0

Location: at Lockbourne Rd. Lat: 39.85160 Long: -82.96840

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		13	26.0	4.08	670	0.71	25.7
40-004	Smallmouth Buffalo	I		M	C	2	4.0	0.63	8100	8.56	2025.0
40-005	Quillback Carpsucker	O		M	C	1	2.0	0.31	1400	1.48	700.0
40-006	River Carpsucker	O		M	C	5	10.0	1.57	7600	8.04	760.0
40-008	Silver Redhorse	I	M	S	R	1	2.0	0.31	1000	1.06	500.0
40-009	Black Redhorse	I	I	S	R	1	2.0	0.31	800	0.85	400.0
40-010	Golden Redhorse	I	M	S	R	36	72.0	11.29	35900	37.95	498.6
40-015	Northern Hog Sucker	I	M	S	R	18	36.0	5.64	8160	8.63	226.6
40-023	Smallmouth Redhorse	I	M	S	R	11	22.0	3.45	13200	13.96	600.0
43-001	Common Carp	O	T	M	G	1	2.0	0.31	3800	4.02	1900.0
43-007	Bigeye Chub	I	I	S	N	46	92.0	14.42	260	0.27	2.8
43-008	Streamline Chub	I	R	S	N	23	46.0	7.21	380	0.40	8.2
43-009	Gravel Chub	I	M	S	N	5	10.0	1.57	60	0.06	6.0
43-021	Silver Shiner	I	I	S	N	9	18.0	2.82	180	0.19	10.0
43-032	Spotfin Shiner	I		M	N	7	14.0	2.19	80	0.08	5.7
43-034	Sand Shiner	I	I	M	N	17	34.0	5.33	70	0.07	2.0
43-035	Mimic Shiner	I	I	M	N	4	8.0	1.25	16	0.02	2.0
43-043	Bluntnose Minnow	O	T	C	N	2	4.0	0.63	16	0.02	4.0
43-044	Central Stoneroller	H		N	N	1	2.0	0.31	6	0.01	3.0
47-002	Channel Catfish			C	F	2	4.0	0.63	6000	6.34	1500.0
47-004	Yellow Bullhead	I	T	C		1	2.0	0.31	2	0.00	1.0
47-008	Stonecat Madtom	I	I	C		2	4.0	0.63	0	0.00	0.0
47-012	Brindled Madtom	I	I	C		1	2.0	0.31	2	0.00	1.0
70-001	Brook Silverside	I	M	M		2	4.0	0.63	4	0.00	1.0
77-003	Rock Bass	C		C	S	3	6.0	0.94	80	0.08	13.3
77-004	Smallmouth Bass	C	M	C	F	2	4.0	0.63	460	0.49	115.0
77-005	Spotted Bass	C		C	F	1	2.0	0.31	20	0.02	10.0
77-006	Largemouth Bass	C		C	F	7	14.0	2.19	840	0.89	60.0
77-008	Green Sunfish	I	T	C	S	16	32.0	5.02	360	0.38	11.2
77-009	Bluegill Sunfish	I	P	C	S	18	36.0	5.64	1680	1.78	46.6
77-010	Orangespotted Sunfish	I		C	S	2	4.0	0.63	30	0.03	7.5
77-011	Longear Sunfish	I	M	C	S	2	4.0	0.63	260	0.27	65.0
77-012	Redear Sunfish	I		C	E	2	4.0	0.63	100	0.11	25.0
77-015	Green X Bluegill Sunfish					3	6.0	0.94	140	0.15	23.3
77-018	Bluegill X Orangespotted Sunfish					1	2.0	0.31	20	0.02	10.0
80-011	Logperch	I	M	S	D	2	4.0	0.63	20	0.02	5.0
80-015	Greenside Darter	I	M	S	D	1	2.0	0.31	6	0.01	3.0
80-016	Banded Darter	I	I	S	D	21	42.0	6.58	10	0.01	0.2
80-017	Variagate Darter	I	I	S	D	1	2.0	0.31	10	0.01	5.0
80-019	Bluebreast Darter	I	R	S	D	13	26.0	4.08	34	0.04	1.3

Appendix Table B-1&. Midwest Biodiversity Institute Fish Species List

Site ID: BW06 River: 02-100 Big Walnut Creek RM: 9.80 Date: 08/09/2022

Time Fished: 2806 Distance: 0.500 Drainge (sq mi): 547.0 Depth: 0

Location: at Lockbourne Rd. Lat: 39.85160 Long: -82.96840

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
80-020	Tippecanoe Darter	I	R	S	D	11	22.0	3.45	10	0.01	0.4
80-026	Sauger X Walleye	P			E	1	2.0	0.31	1000	1.06	500.0
85-001	Freshwater Drum		P	M		1	2.0	0.31	1800	1.90	900.0

No Species: 40 **Nat. Species:** 38 **Hybrids:** 3 **Total Counted:** 319 **Total Rel. Wt. :** 94586

IBI: 54.0 **MIwb:** 10.6

Appendix Table B-1&. Midwest Biodiversity Institute

Fish Species List

Site ID: BW06 River: 02-100 Big Walnut Creek RM: 9.80 Date: 10/07/2022

Time Fished: 3522 Distance: 0.500 Drainge (sq mi): 547.0 Depth: 0

Location: at Lockbourne Rd. Lat: 39.85160 Long: -82.96840

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		91	182.0	22.14	5870	3.09	32.2
40-003	Black Buffalo	I		M	C	1	2.0	0.24	7200	3.79	3600.0
40-004	Smallmouth Buffalo	I		M	C	12	24.0	2.92	46600	24.55	1941.6
40-005	Quillback Carpsucker	O		M	C	5	10.0	1.22	11400	6.00	1140.0
40-006	River Carpsucker	O		M	C	13	26.0	3.16	22800	12.01	876.9
40-009	Black Redhorse	I	I	S	R	1	2.0	0.24	1700	0.90	850.0
40-010	Golden Redhorse	I	M	S	R	34	68.0	8.27	40800	21.49	600.0
40-015	Northern Hog Sucker	I	M	S	R	19	38.0	4.62	8380	4.41	220.5
40-023	Smallmouth Redhorse	I	M	S	R	18	36.0	4.38	21500	11.33	597.2
40-027	Black Buffalo X Smallmouth Buffalo	I		M	C	1	2.0	0.24	5800	3.06	2900.0
43-001	Common Carp	O	T	M	G	2	4.0	0.49	13200	6.95	3300.0
43-007	Bigeye Chub	I	I	S	N	30	60.0	7.30	240	0.13	4.0
43-008	Streamline Chub	I	R	S	N	22	44.0	5.35	440	0.23	10.0
43-009	Gravel Chub	I	M	S	N	3	6.0	0.73	24	0.01	4.0
43-020	Emerald Shiner	I		M	N	11	22.0	2.68	120	0.06	5.4
43-021	Silver Shiner	I	I	S	N	16	32.0	3.89	240	0.13	7.5
43-025	Striped Shiner	I		S	N	14	28.0	3.41	80	0.04	2.8
43-032	Spotfin Shiner	I		M	N	4	8.0	0.97	24	0.01	3.0
43-034	Sand Shiner	I	I	M	N	1	2.0	0.24	4	0.00	2.0
43-035	Mimic Shiner	I	I	M	N	6	12.0	1.46	40	0.02	3.3
43-043	Bluntnose Minnow	O	T	C	N	31	62.0	7.54	180	0.09	2.9
43-044	Central Stoneroller	H		N	N	8	16.0	1.95	140	0.07	8.7
47-008	Stonecat Madtom	I	I	C		4	8.0	0.97	20	0.01	2.5
47-012	Brindled Madtom	I	I	C		1	2.0	0.24	10	0.01	5.0
70-001	Brook Silverside	I	M	M		3	6.0	0.73	6	0.00	1.0
77-004	Smallmouth Bass	C	M	C	F	3	6.0	0.73	2400	1.26	400.0
77-006	Largemouth Bass	C		C	F	3	6.0	0.73	60	0.03	10.0
77-008	Green Sunfish	I	T	C	S	3	6.0	0.73	40	0.02	6.6
77-009	Bluegill Sunfish	I	P	C	S	6	12.0	1.46	140	0.07	11.6
77-011	Longear Sunfish	I	M	C	S	1	2.0	0.24	80	0.04	40.0
77-012	Redear Sunfish	I		C	E	3	6.0	0.73	120	0.06	20.0
80-011	Logperch	I	M	S	D	9	18.0	2.19	100	0.05	5.5
80-014	Johnny Darter	I		C	D	1	2.0	0.24	2	0.00	1.0
80-015	Greenside Darter	I	M	S	D	13	26.0	3.16	40	0.02	1.5
80-016	Banded Darter	I	I	S	D	4	8.0	0.97	8	0.00	1.0
80-019	Bluebreast Darter	I	R	S	D	8	16.0	1.95	20	0.01	1.2
80-020	Tippecanoe Darter	I	R	S	D	3	6.0	0.73	6	0.00	1.0
80-022	Rainbow Darter	I	M	S	D	3	6.0	0.73	8	0.00	1.3

Appendix Table B-1&. Midwest Biodiversity Institute Fish Species List

No Species: 37 **Nat. Species:** 35 **Hybrids:** 1 **Total Counted:** 411 **Total Rel. Wt. :** 189842
IBI: 44.0 **MIwb:** 10.9

Appendix Table B-1&. Midwest Biodiversity Institute

Fish Species List

Site ID: ADN04 River: 02-401 Adena Brook RM: 1.70 Date: 07/12/2022
 Time Fished: 774 Distance: 0.150 Drainge (sq mi): 1.8 Depth: 0
 Location: Overbrook Dr. and Yaronia Dr. Lat: 40.04783 Long: -83.00581

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-016	White Sucker	O	T	S	W	1	2.0	0.33	0	0.00	0.0
43-011	Western Blacknose Dace	G	T	S	N	50	100.0	16.34	0	0.00	0.0
43-013	Creek Chub	G	T	N	N	245	490.0	80.07	0	0.00	0.0
43-044	Central Stoneroller	H		N	N	9	18.0	2.94	0	0.00	0.0
77-008	Green Sunfish	I	T	C	S	1	2.0	0.33	0	0.00	0.0
No Species: 5		Nat. Species: 5		Hybrids: 0		Total Counted: 306		Total Rel. Wt. :		0	
IBI:	26.0	MIwb:		N/A							

Appendix Table B-1&. Midwest Biodiversity Institute Fish Species List

Site ID: ADN03 River: 02-401 Adena Brook RM: 0.80 Date: 07/12/2022

Time Fished: 1396 Distance: 0.150 Drainge (sq mi): 2.2 Depth: 0

Location: Overbrook Dr., dst. Canyon Dr. Lat: 40.04594 Long: -83.01830

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
43-011	Western Blacknose Dace	G	T	S	N	30	60.0	11.03	0	0.00	0.0
43-013	Creek Chub	G	T	N	N	220	440.0	80.88	0	0.00	0.0
43-044	Central Stoneroller	H		N	N	22	44.0	8.09	0	0.00	0.0

No Species: 3 **Nat. Species:** 3 **Hybrids:** 0 **Total Counted:** 272 **Total Rel. Wt. :** 0

IBI: 22.0 **MIwb:** N/A

Appendix Table B-1&. Midwest Biodiversity Institute Fish Species List

Site ID: ADN02 River: 02-401 Adena Brook RM: 0.52 Date: 07/12/2022

Time Fished: 915 Distance: 0.150 Drainge (sq mi): 2.6 Depth: 0

Location: dst. N. High St. Lat: 40.04323 Long: -83.02110

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-016	White Sucker	O	T	S	W	2	4.0	1.06	0	0.00	0.0
43-011	Western Blacknose Dace	G	T	S	N	40	80.0	21.28	0	0.00	0.0
43-013	Creek Chub	G	T	N	N	98	196.0	52.13	0	0.00	0.0
43-044	Central Stoneroller	H		N	N	41	82.0	21.81	0	0.00	0.0
77-008	Green Sunfish	I	T	C	S	7	14.0	3.72	0	0.00	0.0
No Species: 5		Nat. Species: 5		Hybrids: 0		Total Counted: 188		Total Rel. Wt. :		0	
IBI:	28.0	MIwb:		N/A							

Appendix Table B-1&. Midwest Biodiversity Institute Fish Species List

Site ID: ADN01 River: 02-401 Adena Brook RM: 0.23 Date: 07/12/2022

Time Fished: 1634 Distance: 0.150 Drainge (sq mi): 2.7 Depth: 0

Location: Park of Roses Lat: 40.04234 Long: -83.02645

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-016	White Sucker	O	T	S	W	25	50.0	6.54	0	0.00	0.0
43-011	Western Blacknose Dace	G	T	S	N	39	78.0	10.21	0	0.00	0.0
43-013	Creek Chub	G	T	N	N	204	408.0	53.40	0	0.00	0.0
43-044	Central Stoneroller	H		N	N	81	162.0	21.20	0	0.00	0.0
47-004	Yellow Bullhead	I	T	C		1	2.0	0.26	0	0.00	0.0
77-004	Smallmouth Bass	C	M	C	F	1	2.0	0.26	0	0.00	0.0
77-006	Largemouth Bass	C		C	F	9	18.0	2.36	0	0.00	0.0
77-008	Green Sunfish	I	T	C	S	11	22.0	2.88	0	0.00	0.0
80-022	Rainbow Darter	I	M	S	D	10	20.0	2.62	0	0.00	0.0
80-023	Orangethroat Darter	I		S	D	1	2.0	0.26	0	0.00	0.0

No Species: 10 **Nat. Species:** 10 **Hybrids:** 0 **Total Counted:** 382 **Total Rel. Wt. :** 0

IBI: 36.0 **MIwb:** N/A

Appendix Table B-1&. Midwest Biodiversity Institute Fish Species List

Site ID: TUR01 River: 02-402 Turkey Run RM: 0.70 Date: 07/12/2022

Time Fished: 1435 Distance: 0.150 Drainge (sq mi): 2.0 Depth: 0

Location: ust. Tillbury Ave. Lat: 40.03470 Long: -83.04092

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
43-011	Western Blacknose Dace	G	T	S	N	72	144.0	17.65	0	0.00	0.0
43-013	Creek Chub	G	T	N	N	155	310.0	37.99	0	0.00	0.0
77-008	Green Sunfish	I	T	C	S	181	362.0	44.36	0	0.00	0.0

No Species: 3 **Nat. Species:** 3 **Hybrids:** 0 **Total Counted:** 408 **Total Rel. Wt. :** 0

IBI: 24.0 **MIwb:** N/A

Appendix Table B-1&. Midwest Biodiversity Institute Fish Species List

Site ID: RSH01 River: 02-403 Rush Run RM: 0.24 Date: 07/11/2022

Time Fished: 1891 Distance: 0.150 Drainge (sq mi): 2.6 Depth: 0

Location: ust. confluence with Olentangy River Lat: 40.07634 Long: -83.02778

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-016	White Sucker	O	T	S	W	38	76.0	11.91	0	0.00	0.0
43-011	Western Blacknose Dace	G	T	S	N	28	56.0	8.78	0	0.00	0.0
43-013	Creek Chub	G	T	N	N	155	310.0	48.59	0	0.00	0.0
43-044	Central Stoneroller	H		N	N	48	96.0	15.05	0	0.00	0.0
77-006	Largemouth Bass	C		C	F	12	24.0	3.76	0	0.00	0.0
77-008	Green Sunfish	I	T	C	S	22	44.0	6.90	0	0.00	0.0
77-009	Bluegill Sunfish	I	P	C	S	11	22.0	3.45	0	0.00	0.0
80-022	Rainbow Darter	I	M	S	D	2	4.0	0.63	0	0.00	0.0
80-023	Orangethroat Darter	I		S	D	2	4.0	0.63	0	0.00	0.0
80-024	Fantail Darter	I		C	D	1	2.0	0.31	0	0.00	0.0

No Species: 10 **Nat. Species:** 10 **Hybrids:** 0 **Total Counted:** 319 **Total Rel. Wt. :** 0

IBI: 36.0 **MIwb:** N/A

Appendix Table B-1&. Midwest Biodiversity Institute

Fish Species List

Site ID: BAR01 River: 02-404 Bartholomew Run RM: 0.20 Date: 07/11/2022

Time Fished: 1531 Distance: 0.150 Drainge (sq mi): 1.1 Depth: 0

Location: ust. Bennett Parkway Lat: 40.15546 Long: -83.06361

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-016	White Sucker	O	T	S	W	5	10.0	2.08	0	0.00	0.0
43-011	Western Blacknose Dace	G	T	S	N	130	260.0	54.17	0	0.00	0.0
43-013	Creek Chub	G	T	N	N	93	186.0	38.75	0	0.00	0.0
77-008	Green Sunfish	I	T	C	S	1	2.0	0.42	0	0.00	0.0
77-009	Bluegill Sunfish	I	P	C	S	1	2.0	0.42	0	0.00	0.0
80-023	Orangethroat Darter	I		S	D	10	20.0	4.17	0	0.00	0.0

No Species: 6 **Nat. Species:** 6 **Hybrids:** 0 **Total Counted:** 240 **Total Rel. Wt. :** 0

IBI: 32.0 **MIwb:** N/A

Appendix Table B-1&. Midwest Biodiversity Institute Fish Species List

Site ID: BMR01 River: 02-440 Trib. to Olentangy R. (RM 7.82) RM: 0.20 Date: 07/11/2022

Time Fished: 1674 Distance: 0.150 Drainge (sq mi): 2.6 Depth: 0

Location: ust. Confluence with Olentangy R. Kenny Park Lat: 40.06787 Long: -83.03078

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-010	Golden Redhorse	I	M	S	R	5	10.0	2.02	0	0.00	0.0
40-016	White Sucker	O	T	S	W	2	4.0	0.81	0	0.00	0.0
43-011	Western Blacknose Dace	G	T	S	N	49	98.0	19.84	0	0.00	0.0
43-013	Creek Chub	G	T	N	N	91	182.0	36.84	0	0.00	0.0
43-044	Central Stoneroller	H		N	N	66	132.0	26.72	0	0.00	0.0
77-006	Largemouth Bass	C		C	F	9	18.0	3.64	0	0.00	0.0
77-008	Green Sunfish	I	T	C	S	14	28.0	5.67	0	0.00	0.0
77-009	Bluegill Sunfish	I	P	C	S	5	10.0	2.02	0	0.00	0.0
80-022	Rainbow Darter	I	M	S	D	5	10.0	2.02	0	0.00	0.0
80-024	Fantail Darter	I		C	D	1	2.0	0.40	0	0.00	0.0

No Species: 10 **Nat. Species:** 10 **Hybrids:** 0 **Total Counted:** 247 **Total Rel. Wt. :** 0

IBI: 40.0 **MIwb:** N/A

Appendix Table B-1&. Midwest Biodiversity Institute Fish Species List

Site ID: LIN01 River: 02-442 Linworth Run RM: 0.80 Date: 07/11/2022
 Time Fished: 1954 Distance: 0.150 Drainge (sq mi): 2.5 Depth: 0
 Location: ust. Linworth Rd. Lat: 40.09293 Long: -83.04997

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-016	White Sucker	O	T	S	W	3	6.0	0.82	0	0.00	0.0
43-011	Western Blacknose Dace	G	T	S	N	122	244.0	33.15	0	0.00	0.0
43-013	Creek Chub	G	T	N	N	236	472.0	64.13	0	0.00	0.0
43-044	Central Stoneroller	H		N	N	6	12.0	1.63	0	0.00	0.0
77-009	Bluegill Sunfish	I	P	C	S	1	2.0	0.27	0	0.00	0.0
No Species: 0		Nat. Species: 5		Hybrids: 0		Total Counted: 368		Total Rel. Wt. :		0	
IBI: 0.0		MIwb: N/A									

Appendix Table B-1&. Midwest Biodiversity Institute Fish Species List

Site ID: GER01 River: 02-465 Glen Echo Ravine RM: 0.95 Date: 07/27/2022

Time Fished: 702 Distance: 0.150 Drainge (sq mi): 0.5 Depth: 0

Location: Glen Echo Park Lat: 40.01921 Long: -82.99878

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
99-999	No Fish					0	0.0	***.**	0	0.00	*****

No Species: 0 **Nat. Species:** 1 **Hybrids:** 0 **Total Counted:** 0 **Total Rel. Wt. :** 0

IBI: 12.0 **MIwb:** N/A

Appendix Table B-1&. Midwest Biodiversity Institute

Fish Species List

Site ID: TRIB01 River: 02-492 Trib. to Olentangy Riiver @ rm 8.45 RM: 0.10 Date: 07/11/2022

Time Fished: 1219 Distance: 0.150 Drainge (sq mi): 1.0 Depth: 0

Location: dst. OH-315 Lat: 40.07270 Long: -83.03780

Species Code:	Species Name:	Feed Guild	Tolerance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
40-016	White Sucker	O	T	S	W	2	4.0	0.75	0	0.00	0.0
43-011	Western Blacknose Dace	G	T	S	N	70	140.0	26.32	0	0.00	0.0
43-013	Creek Chub	G	T	N	N	171	342.0	64.29	0	0.00	0.0
43-044	Central Stoneroller	H		N	N	3	6.0	1.13	0	0.00	0.0
77-006	Largemouth Bass	C		C	F	2	4.0	0.75	0	0.00	0.0
77-008	Green Sunfish	I	T	C	S	4	8.0	1.50	0	0.00	0.0
77-009	Bluegill Sunfish	I	P	C	S	14	28.0	5.26	0	0.00	0.0

No Species: 0 **Nat. Species:** 7 **Hybrids:** 0 **Total Counted:** 266 **Total Rel. Wt. :** 0

IBI: 0.0 **MIwb:** N/A

APPENDIX C: SCIOTO RIVER MAINSTEM MACROINVERTEBRATE ASSEMBLAGE 2022

- C-1: Scioto River ICI Metrics and ICI Scores 2022**
- C-2: Macroinvertebrate Taxa Grand Ust. Greenlawn Dam 2022**
- C-3: Macroinvertebrate Taxa Grand Dst. Greenlawn Dam 2022**
- C-4: Macroinvertebrate Taxa by Site 2022**

Appendix Table C-1. ICI metrics and narrative for sites in Scioto River mainstem study area sampled by MBI in 2022.

Site ID	River Mile	Drainage Area (sq mi)	Number of				Percent:					Qual. EPT	ICI or Narrative
			Total Taxa ^a	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Mayflies	Caddisflies	Tany-tarsini	Other Dipt/NI	Tolerant Organisms		
Scioto River (02-001)													
Year:2022													
SR01	136.60	1050.00	32(4)	7(4)	3(2)	13(6)	9.7(2)	6.8(2)	0.0(0)	83.2(0)	3.3(2)	16(4)	G
SR02	133.40	1070.00	48									14	MG
SR03	132.60	1070.00	27(4)	5(2)	5(4)	10(4)	13.9(4)	20.2(4)	14.4(4)	50.9(0)	2.2(4)	13(4)	34
SR04	132.10	1610.00	25(4)	5(4)	5(4)	8(4)	12.4(4)	41.0(6)	12.9(4)	33.5(0)	0.4(6)	15(4)	40
SR05	130.10	1620.00	10(0)	2(0)	1(0)	3(0)	0.2(2)	2.9(0)	0.0(0)	96.9(0)	1.4(4)	2(0)	6
SR06	129.00	1620.00	20(2)	4(2)	4(4)	4(2)	0.8(2)	2.7(0)	0.0(0)	96.3(0)	0.2(6)	16(6)	G
SR07	127.70	1620.00	28(4)	6(4)	6(4)	7(4)	2.5(2)	52.2(6)	14.5(4)	29.9(2)	0.9(6)	19(6)	42
SR08.2	127.40	1620.00	33(6)	5(4)	7(6)	13(6)	2.0(2)	21.3(4)	4.2(2)	72.5(0)	6.9(0)	13(4)	34
SRJPMZ	127.00	1620.00	21(2)	1(0)	3(2)	7(4)	0.0(2)	0.9(0)	0.0(0)	99.1(0)	70.8(0)	2(0)	10
SR08	126.50	1630.00	26(4)	5(4)	7(6)	8(4)	1.2(2)	50.3(6)	10.6(4)	37.7(0)	0.4(6)	11(4)	40
SR09	125.40	1640.00	30(4)	5(4)	6(4)	9(4)	1.2(2)	49.4(6)	22.7(6)	26.6(2)	3.7(2)	17(6)	40
SR10	124.50	1670.00	27(4)	7(4)	5(4)	7(4)	2.2(2)	47.5(6)	25.4(6)	23.4(4)	2.8(2)	13(4)	40
SR11	120.10	1700.00	29(4)	5(4)	7(6)	10(4)	6.2(2)	58.1(6)	22.7(6)	12.9(6)	0.3(6)	22(6)	50
SRCSMZ	118.10	1710.00	16(2)	3(2)	2(2)	1(0)	0.3(2)	0.7(0)	0.0(0)	98.8(0)	8.9(0)	1(0)	8
SR12	118.00	1710.00	28(4)	6(4)	7(6)	10(4)	5.8(2)	39.8(6)	29.2(6)	25.2(2)	1.5(4)	18(6)	44
SR13	116.80	2260.00	30(4)	6(4)	9(6)	12(6)	17.5(4)	37.9(4)	24.5(6)	19.6(4)	2.5(4)	21(6)	48
SR14	116.00	2270.00	27(4)	5(4)	7(6)	9(4)	11.4(4)	49.8(6)	30.5(6)	8.1(6)	0.0(6)	22(6)	52
SR15	114.00	2280.00	29(4)	6(4)	8(6)	9(4)	13.7(4)	38.6(6)	36.6(6)	11.1(6)	0.5(6)	21(6)	52
SR16	109.35	2310.00	33(6)	7(4)	9(6)	9(4)	20.3(6)	38.8(6)	24.9(6)	15.6(4)	0.0(6)	20(6)	54
SR17	107.50	2320.00	23(4)	6(4)	8(6)	5(2)	14.5(4)	20.6(4)	36.1(6)	28.8(0)	0.0(6)	18(6)	42
SR18	105.25	2610.00	32(4)	7(4)	9(6)	9(6)	18.5(6)	50.5(6)	18.8(6)	11.3(6)	0.0(6)	21(6)	56
SR19	102.00	2640.00	25(4)	4(2)	7(6)	10(6)	19.3(6)	38.0(4)	30.4(6)	12.1(4)	0.5(6)	18(6)	50
SR20	100.10	3200.00	28(4)	6(4)	8(6)	9(6)	17.8(6)	40.4(6)	28.1(6)	13.2(4)	1.1(6)	18(6)	54
SR21	99.40	3220.00	25(4)	5(4)	8(6)	9(6)	28.1(6)	37.1(4)	17.9(6)	16.9(4)	0.0(6)	26(6)	52
SR22	99.00	3220.00	30(4)	6(4)	7(4)	12(6)	14.7(4)	51.7(6)	9.8(4)	23.7(2)	0.8(6)	20(6)	46
SR23	97.90	3220.00	27(4)	5(4)	7(4)	10(6)	36.4(6)	49.8(6)	5.4(2)	8.0(6)	0.3(6)	23(6)	50
Big Walnut Creek (02-100)													
Year:2022													
BW06	9.60	547.00	43(6)	9(6)	5(4)	18(6)	37.2(6)	16.3(4)	23.9(4)	20.1(6)	11.9(0)	16(4)	46

^a For HD samples represents total QUANT taxa, but for QUAL samples represents QUAL taxa.

Appendix C-2. Total macroinvertebrate taxa report for the Scioto River mainstem upstream of Greenlawn dam and in the lower Olentangy River downstream from the Dodridge Dam sampled in 2022.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
83300	<i>Glyptotendipes (G.) sp</i>	MT	D	48383	54.75	6	8
84450	<i>Polypedilum (Uresipedilum) flavum</i>	F	D	12040	13.63	9	9
52200	<i>Cheumatopsyche sp</i>	F	C	8231	9.31	9	9
01801	<i>Turbellaria</i>	F	N	3484	3.94	10	10
85625	<i>Rheotanytarsus sp</i>	F	T	2445	2.77	8	8
11130	<i>Baetis intercalaris</i>	F	M	2172	2.46	9	9
52430	<i>Ceratopsyche morosa group</i>	MI	C	1823	2.06	9	9
16700	<i>Tricorythodes sp</i>	MI	M	1507	1.71	9	9
11120	<i>Baetis flavistriga</i>	F	M	1362	1.54	5	5
51206	<i>Cyrnellus fraternus</i>	F	C	1299	1.47	1	7
13561	<i>Maccaffertium pulchellum</i>	MI	M	531	0.6	5	5
13400	<i>Stenacron sp</i>	F	M	514	0.58	9	10
83051	<i>Dicrotendipes simpsoni</i>	T	D	447	0.51	2	3
13570	<i>Maccaffertium terminatum</i>	MI	M	427	0.48	8	8
03600	<i>Oligochaeta</i>	T	N	389	0.44	8	9
77140	<i>Ablabesmyia peleensis</i>	F	D	314	0.36	0	1
78450	<i>Nilotanypus fimbriatus</i>	F	D	264	0.3	0	5
84700	<i>Stenochironomus sp</i>	F	D	237	0.27	0	2
13510	<i>Maccaffertium exiguum</i>	MI	M	186	0.21	3	4
87540	<i>Hemerodromia sp</i>	F	D	148	0.17	2	7
82220	<i>Tvetenia discoloripes group</i>	MI	D	141	0.16	1	2
83040	<i>Dicrotendipes neomodestus</i>	F	D	139	0.16	6	6
53800	<i>Hydroptila sp</i>	F	C	136	0.15	6	7
77500	<i>Conchapelopia sp</i>	F	D	111	0.13	3	4
77800	<i>Helopelopia sp</i>	F	D	106	0.12	7	7
81240	<i>Nanocladius (N.) distinctus</i>	MT	D	98	0.11	3	6
84490	<i>Polypedilum (Cerobregma) ontario</i>	MI	D	88	0.1	2	3

Appendix C-2 . continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
52801	<i>Potamyia flava</i>	MI	C	78	0.09	0	2
17200	<i>Caenis sp</i>	F	M	76	0.09	3	3
12200	<i>Isonychia sp</i>	MI	M	68	0.08	2	4
80420	<i>Cricotopus (C.) bicinctus</i>	T	D	62	0.07	3	3
96900	<i>Ferrissia sp</i>	F	N	59	0.07	5	7
01320	<i>Hydra sp</i>	F	N	57	0.06	0	3
22300	<i>Argia sp</i>	F	O	57	0.06	9	10
13521	<i>Stenonema femoratum</i>	F	M	52	0.06	5	5
79100	<i>Thienemannimyia group</i>	F	D	46	0.05	0	1
77130	<i>Ablabesmyia rhamphe group</i>	MT	D	44	0.05	0	1
83158	<i>Endochironomus nigricans</i>	MT	D	44	0.05	5	5
77120	<i>Ablabesmyia mallochi</i>	F	D	44	0.05	8	8
08601	<i>Hydrachnidia</i>	F	N	40	0.05	2	4
93900	<i>Elimia sp</i>	MI	N	37	0.04	8	9
74100	<i>Simulium sp</i>	F	D	36	0.04	5	7
77100	<i>Ablabesmyia sp</i>	F	D	31	0.04	0	1
80400	<i>Cricotopus sp</i>	F	D	31	0.04	0	1
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	F	D	31	0.04	0	1
84800	<i>Tribelos jucundum</i>	MT	D	31	0.04	0	1
83400	<i>Harnischia sp</i>	F	D	31	0.04	1	2
03451	<i>Urnatella gracilis</i>	MI	N	27	0.03	0	1
69400	<i>Stenelmis sp</i>	F	O	26	0.03	9	9
01900	<i>Nemertea</i>	F	N	24	0.03	0	1
82501	<i>Chironomini</i>		D	24	0.03	0	1
83000	<i>Dicrotendipes sp</i>	F	D	24	0.03	0	1
96930	<i>Laevapex fuscus</i>	MT	N	24	0.03	3	4
81231	<i>Nanocladius (N.) crassicornus or N. (N.) "rectin"</i>	F	D	23	0.03	0	1
59415	<i>Nectopsyche exquisita</i>	MI	C	17	0.02	5	5
16324	<i>Teloganopsis deficiens</i>	I	M	16	0.02	0	1

Appendix C-2 . continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
78200	<i>Larsia sp</i>	MT	D	16	0.02	0	1
80363	<i>Corynoneura sp 12</i>	MI	D	16	0.02	0	1
80370	<i>Corynoneura lobata</i>	F	D	16	0.02	0	1
82141	<i>Thienemanniella xena</i>	F	D	16	0.02	0	1
03000	<i>Ectoprocta</i>	F		14	0.02	2	5
52560	<i>Hydropsyche orris</i>	MI	C	14	0.02	3	4
59970	<i>Petrophila sp</i>	MI	O	13	0.01	9	9
11020	<i>Acerpenna pygmaea</i>	MI	M	11	0.01	1	1
03360	<i>Plumatella sp</i>	F	N	9	0.01	1	2
98600	<i>Sphaerium sp</i>	F	N	9	0.01	3	4
97601	<i>Corbicula fluminea</i>	F	N	9	0.01	7	8
11001	<i>Baetidae</i>		M	8	0.01	0	1
87501	<i>Empididae</i>	F	D	8	0.01	0	1
68901	<i>Macronychus glabratus</i>	F	O	4	0	1	4
13550	<i>Maccaffertium mexicanum integrum</i>	MI	M	3	0	0	1
34715	<i>Agnatina flavescens</i>	I	S	3	0	1	3
95100	<i>Physella sp</i>	T	N	3	0	6	6
68601	<i>Ancyronyx variegata</i>	F	O	2	0	1	2
21001	<i>Calopterygidae</i>	F	O	1	0	0	1
21300	<i>Hetaerina sp</i>	F	O	1	0	0	1
93200	<i>Hydrobiidae</i>	F	N	1	0	2	2
04930	<i>Erpobdella sp</i>	MT	N	1	0	2	3
52520	<i>Hydropsyche bidens</i>	MI	C	1	0	2	3
08200	<i>Orconectes sp</i>	F	N	1	0	3	4
05800	<i>Caecidotea sp</i>	T	N	1	0	6	6
06201	<i>Hyaella azteca</i>	F	N	1	0	7	7
13000	<i>Leucrocota sp</i>	MI	M	1	0	8	8
04664	<i>Helobdella stagnalis</i>	T	N	0	0	1	1
04964	<i>Erpobdella microstoma</i>	MT	N	0	0	1	1

Appendix C-2 . continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
18100	<i>Anthopotamus sp</i>	MI	M	0	0	1	1
18619	<i>Ephemera simulans</i>	MI	M	0	0	1	1
23600	<i>Aeshna sp</i>	MT	O	0	0	1	1
24107	<i>Nasiaeschna pentacantha</i>	MT	O	0	0	1	1
27400	<i>Neurocordulia sp</i>	F	O	0	0	1	1
42700	<i>Belostoma sp</i>	T	O	0	0	1	1
43300	<i>Ranatra sp</i>	F	O	0	0	1	1
48410	<i>Corydalus cornutus</i>	MI	O	0	0	1	1
67000	<i>Helophorus sp</i>	MT	O	0	0	1	1
68201	<i>Scirtidae</i>	F	O	0	0	1	1
68708	<i>Dubiraphia vittata group</i>	F	O	0	0	1	1
71900	<i>Tipula sp</i>	F	D	0	0	1	1
72900	<i>Culex sp</i>	T	D	0	0	1	1
80410	<i>Cricotopus (C.) sp</i>	F	D	0	0	1	1
80510	<i>Cricotopus (Isocladius) sylvestris group</i>	T	D	0	0	1	1
81060	<i>Lopescladius sp</i>	MI	D	0	0	1	1
82880	<i>Cryptotendipes sp</i>	F	D	0	0	1	1
84000	<i>Parachironomus sp</i>	MT	D	0	0	1	1
84460	<i>Polypedilum (P.) fallax group</i>	F	D	0	0	1	1
84888	<i>Xenochironomus xenolabis</i>	F	D	0	0	1	1
84960	<i>Pseudochironomus sp</i>	F	D	0	0	1	1
85500	<i>Paratanytarsus sp</i>	F	T	0	0	1	1
85840	<i>Tanytarsus sepp</i>	F	T	0	0	1	1
96264	<i>Planorbella (Pierosoma) pilsbryi</i>	T	N	0	0	1	1
99100	<i>Pyganodon grandis</i>	F	N	0	0	1	1
11119	<i>Plauditus dubius or P. virilis</i>	I	M	0	0	2	2
13100	<i>Nixe sp</i>	MI	M	0	0	2	2
21200	<i>Calopteryx sp</i>	F	O	0	0	2	2
27001	<i>Corduliidae</i>		O	0	0	2	2

Appendix C-2 . continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
45400	<i>Trichocorixa sp</i>	MT	O	0	0	2	2
59100	<i>Ceraclea sp</i>	MI	C	0	0	2	2
59500	<i>Oecetis sp</i>	F	C	0	0	2	2
59715				0	0	2	2
60900	<i>Peltodytes sp</i>	MT	O	0	0	2	2
65800	<i>Berosus sp</i>	MT	O	0	0	2	2
80310	<i>Cardiocladius obscurus</i>	MI	D	0	0	2	2
82822	<i>Cryptochironomus eminentia</i>	F	D	0	0	2	2
84520	<i>Polypedilum (Tripodura) halterale group</i>	MT	D	0	0	2	2
85265	<i>Cladotanytarsus vanderwulpi group sp 5</i>	MI	T	0	0	2	2
85821	<i>Tanytarsus glabrescens group sp 7</i>	F	T	0	0	2	2
92615	<i>Cipangopaludina japonica</i>	MT	N	0	0	2	2
97710	<i>Dreissena polymorpha</i>	F	N	0	0	2	2
04666	<i>Helobdella papillata</i>	MT	N	0	0	3	3
08250	<i>Orconectes (Procericambarus) rusticus</i>	F	N	0	0	3	3
11650	<i>Procloeon sp (w/ hindwing pads)</i>	MI	M	0	0	3	3
44501	<i>Corixidae</i>	F	O	0	0	3	3
50315	<i>Chimarra obscura</i>	MI	C	0	0	3	3
58505	<i>Helicopsyche borealis</i>	MI	C	0	0	3	3
59407	<i>Nectopsyche candida</i>	MI	C	0	0	3	3
77750	<i>Hayesomyia senata or Thienemannimyia norer</i>	F	D	0	0	3	3
85800	<i>Tanytarsus sp</i>	F	T	0	0	3	3
04901	<i>Erpobdellidae</i>	MT	N	0	0	4	4
11200	<i>Callibaetis sp</i>	MT	M	0	0	4	4
18600	<i>Ephemera sp</i>	MI	M	0	0	4	4
26700	<i>Macromia sp</i>	MI	O	0	0	4	4
82820	<i>Cryptochironomus sp</i>	F	D	0	0	4	4
05900	<i>Lirceus sp</i>	MT	N	0	0	5	5
06700	<i>Crangonyx sp</i>	MT	N	0	0	5	5

Appendix C-2 . continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
78655	<i>Procladius (Holotanypus) sp</i>	MT	D	0	0	5	5
82730	<i>Chironomus (C.) decorus group</i>	T	D	0	0	5	5
53400	<i>Protoptila sp</i>	I	C	0	0	7	7
68075	<i>Psephenus herricki</i>	MI	O	0	0	7	7
84470	<i>Polypedilum (P.) illinoense</i>	T	D	0	0	7	7
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	F	D	0	0	7	7
22001	<i>Coenagrionidae</i>	T	O	0	0	9	9
Ohio EPA Tolerance Codes: I - Intolerant; MI - Moderately Intolerant; F - Facultative; MT - Moderately Tolerant; T - Tolerant							
Taxa Group Codes: M - Mayflies; N - Non insects; O - Other Dipterans; C - Caddisflies; D - Dipterans; T - Tanytarsini Midge; S - Stoneflies							

Appendix C-3. Total macroinvertebrate taxa report for the Scioto River mainstem downstream of Greenlawn dam sampled in .

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
85625	<i>Rheotanytarsus sp</i>	F	T	42915	20.42	17	18
52200	<i>Cheumatopsyche sp</i>	F	C	39253	18.68	18	18
83300	<i>Glyptotendipes (G.) sp</i>	MT	D	22858	10.88	20	20
52560	<i>Hydropsyche orris</i>	MI	C	22287	10.6	13	18
84450	<i>Polypedilum (Uresipedilum) flavum</i>	F	D	16511	7.86	16	18
03600	<i>Oligochaeta</i>	T	N	10539	5.01	18	20
52570	<i>Hydropsyche simulans</i>	MI	C	9746	4.64	15	18
13570	<i>Maccaffertium terminatum</i>	MI	M	8889	4.23	19	19
52801	<i>Potamyia flava</i>	MI	C	7559	3.6	16	18
11130	<i>Baetis intercalaris</i>	F	M	5401	2.57	17	18
12200	<i>Isonychia sp</i>	MI	M	4246	2.02	14	16
77750	<i>Hayesomyia senata or Thienemannimyia norena</i>	F	D	2565	1.22	14	18
13510	<i>Maccaffertium exiguum</i>	MI	M	2337	1.11	7	16
52430	<i>Ceratopsyche morosa group</i>	MI	C	1705	0.81	12	19
74100	<i>Simulium sp</i>	F	D	1414	0.67	13	13
52520	<i>Hydropsyche bidens</i>	MI	C	1182	0.56	7	12
77500	<i>Conchapelopia sp</i>	F	D	716	0.34	2	6
51206	<i>Cyrnellus fraternus</i>	F	C	666	0.32	8	12
16700	<i>Tricorythodes sp</i>	MI	M	652	0.31	18	19
01801	<i>Turbellaria</i>	F	N	648	0.31	13	19
84300	<i>Phaenopsectra obediens group</i>	F	D	641	0.3	9	10
83050	<i>Dicrotendipes lucifer</i>	MT	D	533	0.25	1	4
81240	<i>Nanocladius (N.) distinctus</i>	MT	D	503	0.24	1	8
87540	<i>Hemerodromia sp</i>	F	D	440	0.21	3	12
13540	<i>Maccaffertium mediopunctatum</i>	MI	M	438	0.21	3	4
80410	<i>Cricotopus (C.) sp</i>	F	D	298	0.14	10	12
81231	<i>Nanocladius (N.) crassicornus or N. (N.) "rectinervis"</i>	F	D	267	0.13	1	6
50315	<i>Chimarra obscura</i>	MI	C	254	0.12	4	8

Appendix C-3 . continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
82220	<i>Tvetenia discoloripes group</i>	MI	D	251	0.12	0	5
77130	<i>Ablabesmyia rhamphe group</i>	MT	D	226	0.11	10	10
59970	<i>Petrophila sp</i>	MI	O	216	0.1	14	15
96900	<i>Ferrissia sp</i>	F	N	219	0.1	9	10
84040	<i>Parachironomus frequens</i>	F	D	212	0.1	4	6
83040	<i>Dicrotendipes neomodestus</i>	F	D	199	0.09	13	14
82100	<i>Thienemanniella sp</i>		D	185	0.09	5	7
82130	<i>Thienemanniella similis</i>	MI	D	192	0.09	3	7
83051	<i>Dicrotendipes simpsoni</i>	T	D	199	0.09	0	1
01900	<i>Nemertea</i>	F	N	167	0.08	0	6
01320	<i>Hydra sp</i>	F	N	160	0.08	0	5
84700	<i>Stenochironomus sp</i>	F	D	175	0.08	1	3
69400	<i>Stenelmis sp</i>	F	O	137	0.07	18	18
53800	<i>Hydroptila sp</i>	F	C	136	0.06	10	10
13400	<i>Stenacron sp</i>	F	M	111	0.05	17	18
78450	<i>Nilotanypus fimbriatus</i>	F	D	112	0.05	0	5
82770	<i>Chironomus (C.) riparius group</i>	T	D	99	0.05	3	3
74501	<i>Ceratopogonidae</i>	T	D	113	0.05	0	3
80510	<i>Cricotopus (Isocladius) sylvestris group</i>	T	D	99	0.05	2	2
77001	<i>Tanypodinae</i>		D	99	0.05	0	1
17200	<i>Caenis sp</i>	F	M	75	0.04	16	16
52580	<i>Hydropsyche valanis</i>	MI	C	75	0.04	3	5
13590	<i>Maccaffertium vicarium</i>	MI	M	82	0.04	1	3
52521	<i>Hydropsyche bidens or H. orris</i>	MI	C	87	0.04	0	1
96801	<i>Ancylidae</i>	F	N	85	0.04	0	1
93900	<i>Elimia sp</i>	MI	N	60	0.03	18	18
13561	<i>Maccaffertium pulchellum</i>	MI	M	73	0.03	4	6
85840	<i>Tanytarsus sepp</i>	F	T	68	0.03	4	6
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	F	D	66	0.03	2	4

Appendix C-3 . continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
05800	<i>Caecidotea sp</i>	T	N	42	0.02	18	18
82730	<i>Chironomus (C.) decorus group</i>	T	D	35	0.02	17	17
77120	<i>Ablabesmyia mallochii</i>	F	D	33	0.02	15	15
68901	<i>Macronychus glabratus</i>	F	O	48	0.02	5	10
08601	<i>Hydrachnidia</i>	F	N	48	0.02	4	4
80420	<i>Cricotopus (C.) bicinctus</i>	T	D	35	0.02	4	4
85821	<i>Tanytarsus glabrescens group sp 7</i>	F	T	35	0.02	2	3
78750	<i>Rheopelopia paramaculipennis</i>	MI	D	39	0.02	1	2
22300	<i>Argia sp</i>	F	O	17	0.01	17	17
59407	<i>Nectopsyche candida</i>	MI	C	17	0.01	14	15
97601	<i>Corbicula fluminea</i>	F	N	28	0.01	12	14
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	F	D	20	0.01	11	11
95100	<i>Physella sp</i>	T	N	12	0.01	9	10
68601	<i>Ancyronyx variegata</i>	F	O	13	0.01	4	7
03360	<i>Plumatella sp</i>	F	N	31	0.01	4	6
80430	<i>Cricotopus (C.) tremulus group</i>	MT	D	20	0.01	3	4
87501	<i>Empididae</i>	F	D	20	0.01	1	4
54160	<i>Ochrotrichia sp</i>	MI	C	29	0.01	2	2
53201	<i>Glossosomatidae</i>	MI	C	16	0.01	2	2
78140	<i>Labrundinia pilosella</i>	F	D	16	0.01	1	2
48410	<i>Corydalus cornutus</i>	MI	O	19	0.01	0	2
03451	<i>Urnatella gracilis</i>	MI	N	17	0.01	0	2
84420	<i>Polypedilum (P.) n.sp 1</i>	MI	D	20	0.01	0	1
59580	<i>Oecetis persimilis</i>	MI	C	17	0.01	0	1
59500	<i>Oecetis sp</i>	F	C	16	0.01	0	1
80360	<i>Corynoneura floridaensis</i>	MI	D	16	0.01	0	1
18100	<i>Anthopotamus sp</i>	MI	M	8	0	16	16
22001	<i>Coenagrionidae</i>	T	O	7	0	15	15

Appendix C-3 . continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
06700	<i>Crangonyx sp</i>	MT	N	0	0	15	15
84470	<i>Polypedilum (P.) illinoense</i>	T	D	0	0	15	15
53400	<i>Protoptila sp</i>	I	C	0	0	12	12
11670	<i>Proclaeon viridoculare</i>	MI	M	0	0	11	11
13000	<i>Leucrocuta sp</i>	MI	M	2	0	10	10
21300	<i>Hetaerina sp</i>	F	O	1	0	7	7
04666	<i>Helobdella papillata</i>	MT	N	0	0	7	7
43300	<i>Ranatra sp</i>	F	O	0	0	7	7
68130	<i>Helichus sp</i>	F	O	0	0	7	7
78655	<i>Procladius (Holotanypus) sp</i>	MT	D	0	0	7	7
82820	<i>Cryptochironomus sp</i>	F	D	0	0	7	7
97710	<i>Dreissena polymorpha</i>	F	N	0	0	7	7
99400	<i>Quadrula quadrula</i>	MI	N	0	0	7	7
99680	<i>Leptodea fragilis</i>	MI	N	0	0	7	7
11620	<i>Paracloeodes minutus</i>	MI	M	0	0	6	6
13521	<i>Stenonema femoratum</i>	F	M	0	0	6	6
23909	<i>Boyeria vinosa</i>	F	O	0	0	6	6
45400	<i>Trichocorixa sp</i>	MT	O	0	0	6	6
84520	<i>Polypedilum (Tripodura) halterale group</i>	MT	D	0	0	6	6
98600	<i>Sphaerium sp</i>	F	N	0	0	6	6
93200	<i>Hydrobiidae</i>	F	N	5	0	5	6
34715	<i>Agnatina flavescens</i>	I	S	3	0	5	6
04964	<i>Erpobdella microstoma</i>	MT	N	0	0	5	5
08250	<i>Orconectes (Procericambarus) rusticus</i>	F	N	0	0	5	5
44501	<i>Corixidae</i>	F	O	0	0	5	5
60900	<i>Peltodytes sp</i>	MT	O	0	0	5	5
85800	<i>Tanytarsus sp</i>	F	T	0	0	5	5
99700	<i>Potamilus alatus</i>	MI	N	0	0	5	5
03000	<i>Ectoprocta</i>	F		7	0	4	5

Appendix C-3 . continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
01200	<i>Cordylophora caspia</i>	MT	N	4	0	1	5
04664	<i>Helobdella stagnalis</i>	T	N	1	0	4	4
00401	<i>Spongillidae</i>	F	N	0	0	4	4
13100	<i>Nixe sp</i>	MI	M	0	0	4	4
24107	<i>Nasiaeschna pentacantha</i>	MT	O	0	0	4	4
65800	<i>Berosus sp</i>	MT	O	0	0	4	4
68075	<i>Psephenus herricki</i>	MI	O	0	0	4	4
84155	<i>Paralauterborniella nigrohalteralis</i>	F	D	0	0	4	4
84612	<i>Saetheria tylus</i>	F	D	0	0	4	4
99380	<i>Quadrula pustulosa pustulosa</i>	MI	N	0	0	4	4
26700	<i>Macromia sp</i>	MI	O	1	0	3	3
04901	<i>Erpobdellidae</i>	MT	N	0	0	3	3
08200	<i>Orconectes sp</i>	F	N	0	0	3	3
11119	<i>Plauditus dubius or P. virilis</i>	I	M	0	0	3	3
11150	<i>Labiobaetis propinquus</i>	MI	M	0	0	3	3
11200	<i>Callibaetis sp</i>	MT	M	0	0	3	3
34605	<i>Perlinella drymo</i>	MI	S	0	0	3	3
42700	<i>Belostoma sp</i>	T	O	0	0	3	3
72900	<i>Culex sp</i>	T	D	0	0	3	3
80310	<i>Cardiocladius obscurus</i>	MI	D	0	0	3	3
99640	<i>Truncilla donaciformis</i>	MI	N	0	0	3	3
99880	<i>Lampsilis cardium</i>	MI	N	0	0	3	3
04930	<i>Erpobdella sp</i>	MT	N	0	0	2	2
11121	<i>Labiobaetis sp</i>	MI	M	0	0	2	2
11123	<i>Labiobaetis dardanus</i>	MI	M	0	0	2	2
11600	<i>Paracloeodes fleeki</i>	MI	M	0	0	2	2
11650	<i>Procloeon sp (w/ hindwing pads)</i>	MI	M	0	0	2	2
18600	<i>Ephemera sp</i>	MI	M	0	0	2	2

Appendix C-3 . continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
24800	<i>Gomphurus sp</i>	MI	O	0	0	2	2
24900	<i>Gomphus sp</i>	F	O	0	0	2	2
34600	<i>Perlinella sp</i>	MI	S	0	0	2	2
59415	<i>Nectopsyche exquisita</i>	MI	C	0	0	2	2
63900	<i>Laccophilus sp</i>	T	O	0	0	2	2
67800	<i>Tropisternus sp</i>	T	O	0	0	2	2
68700	<i>Dubiraphia sp</i>	F	O	0	0	2	2
78100	<i>Labrundinia sp</i>	F	D	0	0	2	2
78599	<i>Pentaneura sp</i>	F	D	0	0	2	2
82710	<i>Chironomus (C.) sp</i>	MT	D	0	0	2	2
82822	<i>Cryptochironomus eminentia</i>	F	D	0	0	2	2
83400	<i>Harnischia sp</i>	F	D	0	0	2	2
84000	<i>Parachironomus sp</i>	MT	D	0	0	2	2
84960	<i>Pseudochironomus sp</i>	F	D	0	0	2	2
96930	<i>Laevapex fuscus</i>	MT	N	0	0	2	2
99240	<i>Lasmigona complanata</i>	MI	N	0	0	2	2
99580	<i>Obliquaria reflexa</i>	MI	N	0	0	2	2
99720	<i>Potamilus ohioensis</i>	MI	N	0	0	2	2
99780	<i>Ligumia recta</i>	MI	N	0	0	2	2
53501	<i>Hydroptilidae</i>	F	C	8	0	1	2
04660	<i>Helobdella sp</i>	MT	N	1	0	1	2
13500	<i>Maccaffertium sp</i>	MI	M	1	0	1	2
03073	<i>Lophopodella carteri</i>	MI	N	0	0	1	1
03121	<i>Paludicella articulata</i>	MI	N	0	0	1	1
04601	<i>Glossiphoniidae</i>	MT	N	0	0	1	1
04615	<i>Actinobdella inequiannulata</i>	MT	N	0	0	1	1
04685	<i>Placobdella ornata</i>	MT	N	0	0	1	1
04687	<i>Placobdella parasitica</i>	MT	N	0	0	1	1

Appendix C-3 . continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
04960	<i>Erpobdella sp (= Mooreobdella)</i>	MT	N	0	0	1	1
06201	<i>Hyalella azteca</i>	F	N	0	0	1	1
11010	<i>Acentrella sp</i>	I	M	0	0	1	1
11155	<i>Iswaeon anoka</i>	MI	M	0	0	1	1
11245	<i>Anafroptilum or Neocoloeon sp. =(Centroptilum sp.)</i>	F	M	0	0	1	1
11651	<i>Procloeon sp (w/o hindwing pads)</i>	MI	M	0	0	1	1
23905	<i>Boyeria grafiana</i>	MI	O	0	0	1	1
24700	<i>Dromogomphus sp</i>	F	O	0	0	1	1
24820	<i>Gomphurus externus</i>	MI	O	0	0	1	1
25010	<i>Hagenius brevistylus</i>	F	O	0	0	1	1
25600	<i>Stylurus sp</i>	MI	O	0	0	1	1
26600	<i>Didymops transversa</i>	MT	O	0	0	1	1
27001	<i>Corduliidae</i>		O	0	0	1	1
27400	<i>Neurocordulia sp</i>	F	O	0	0	1	1
34700	<i>Agnetina capitata complex</i>	MI	S	0	0	1	1
45900	<i>Notonecta sp</i>	T	O	0	0	1	1
51300	<i>Neureclipsis sp</i>	MI	C	0	0	1	1
59300	<i>Mystacides sp</i>	MI	C	0	0	1	1
59720	<i>Triaenodes ignitus</i>	MI	C	0	0	1	1
68708	<i>Dubiraphia vittata group</i>	F	O	0	0	1	1
71900	<i>Tipula sp</i>	F	D	0	0	1	1
79020	<i>Tanypus neopunctipennis</i>	T	D	0	0	1	1
79100	<i>Thienemannimyia group</i>	F	D	0	0	1	1
80400	<i>Cricotopus sp</i>	F	D	0	0	1	1
80440	<i>Cricotopus (C.) trifascia</i>	F	D	0	0	1	1
80700	<i>Eukiefferiella sp</i>		D	0	0	1	1
82501	<i>Chironomini</i>		D	0	0	1	1
82600	<i>Axarus sp</i>	F	D	0	0	1	1

Appendix C-3. continued.							
Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
82880	<i>Cryptotendipes sp</i>	F	D	0	0	1	1
82885	<i>Cryptotendipes pseudotener</i>	F	D	0	0	1	1
83158	<i>Endochironomus nigricans</i>	MT	D	0	0	1	1
83820	<i>Microtendipes "caelum" (sensu Simpson & Bode, 1980)</i>	MI	D	0	0	1	1
84010	<i>Parachironomus "abortivus" (sensu Simpson & Bode, 1980)</i>	MT	D	0	0	1	1
84020	<i>Parachironomus carinatus</i>	F	D	0	0	1	1
84400	<i>Polypedilum sp</i>		D	0	0	1	1
84888	<i>Xenochironomus xenolabis</i>	F	D	0	0	1	1
85230	<i>Cladotanytarsus mancus group</i>	F	T	0	0	1	1
85260	<i>Cladotanytarsus vanderwulpi group</i>		T	0	0	1	1
86001	<i>Tabanidae</i>	F	D	0	0	1	1
92615	<i>Cipangopaludina japonica</i>	MT	N	0	0	1	1
98001	<i>Pisidiidae</i>		N	0	0	1	1
99320	<i>Tritogonia verrucosa</i>	MI	N	0	0	1	1
99890	<i>Epioblasma obliquata obliquata</i>		N	0	0	1	1
84460	<i>Polypedilum (P.) fallax group</i>	F	D	9	0	0	1
11118	<i>Plauditus dubius</i>	MI	M	4	0	0	1
13550	<i>Maccaffertium mexicanum integrum</i>	MI	M	4	0	0	1
11001	<i>Baetidae</i>		M	2	0	0	1
11015	<i>Acerpenna sp</i>	MI	M	1	0	0	1
98200	<i>Pisidium sp</i>	MT	N	1	0	0	1
Ohio EPA Tolerance Codes: I - Intolerant; MI - Moderately Intolerant; F - Facultative; MT - Moderately Tolerant; T - Tolerant							
Taxa Group Codes: M - Mayflies; N - Non insects; O - Other Dipterans; C - Caddisflies; D - Dipterans; T - Tanytarsini Midge; S - Stoneflies							

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/12/2022* RM: **136.60**

Site ID: **SR01** Location: *Dst. 5th Ave.* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01320	Hydra sp	F		33	80310	Cardiocladius obscurus	MI		+
01801	Turbellaria	F		366 +	80370	Corynoneura lobata	F		16
03000	Ectoprocta	F		2	81240	Nanocladius (N.) distinctus	MT		+
03600	Oligochaeta	T		76 +	82141	Thienemanniella xena	F		16
04666	Helobdella papillata	MT		+	82730	Chironomus (C.) decorus group	T		+
04901	Erpobdellidae	MT		+	83040	Dicrotendipes neomodestus	F		89 +
05800	Caecidotea sp	T		+	83051	Dicrotendipes simpsoni	T		133 +
05900	Lirceus sp	MT		+	83158	Endochironomus nigricans	MT		44 +
06201	Hyalella azteca	F		+	83300	Glyptotendipes (G.) sp	MT		355 +
06700	Crangonyx sp	MT		+	84450	Polypedilum (Uresipedilum) flavum	F		3950 +
08200	Orconectes sp	F		+	84470	Polypedilum (P.) illinoense	T		+
11020	Acerpenna pygmaea	MI		11 +	84960	Pseudochironomus sp	F		+
11120	Baetis flavistriga	F		13 +	87540	Hemerodromia sp	F		2
11130	Baetis intercalaris	F		472 +	92615	Cipangopaludina japonica	MT		+
11650	Proclleon sp (w/ hindwing pads)	MI		+	93200	Hydrobiidae	F		+
13000	Leucrocuta sp	MI		1 +	93900	Elimia sp	MI		1 +
13400	Stenacron sp	F		40 +	95100	Physella sp	T		3 +
13521	Stenonema femoratum	F		+	96264	Planorbella (Pierosoma) pilsbryi	T		+
13570	Maccaffertium terminatum	MI		23 +	96900	Ferrissia sp	F		+
16700	Tricorythodes sp	MI		60 +	97601	Corbicula fluminea	F		1
22001	Coenagrionidae	T		+	98600	Sphaerium sp	F		1 +
22300	Argia sp	F		18 +	99100	Pyganodon grandis	F		+
27001	Corduliidae			+					
51206	Cynellus fraternus	F		11	No. Quantitative Taxa: 32		Total Taxa; 65		
52200	Cheumatopsyche sp	F		383 +	No. Qualitative Taxa: 55		ICI: G		
52430	Ceratopsyche morosa group	MI		38 +	Number of Organisms: 6386		Qual EPT: 16		
52520	Hydropsyche bidens	MI		+					
52560	Hydropsyche orris	MI		+					
53800	Hydroptila sp	F		+					
59100	Ceraclea sp	MI		+					
59500	Oecetis sp	F		+					
59970	Petrophila sp	MI		+					
68075	Psephenus herricki	MI		+					
68201	Scirtidae	F		+					
68708	Dubiraphia vittata group	F		+					
69400	Stenelmis sp	F		+					
74100	Simulium sp	F		+					
77120	Ablabesmyia mallochi	F		44 +					
77130	Ablabesmyia rhamphe group	MT		44					
77500	Conchapelopia sp	F		+					
77800	Helopelopia sp	F		44 +					
78200	Larsia sp	MT		16					
78450	Nilotanypus fimbriatus	F		80					

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/12/2022* RM: **133.40**

Site ID: **SR02** Location: *dst. Dublin Rd Dam* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		+	84888	Xenochironomus xenolabis	F		+
03360	Plumatella sp	F		+	85625	Rheotanytarsus sp	F		+
03600	Oligochaeta	T		+	93900	Elimia sp	MI		+
05800	Caecidotea sp	T		+	95100	Physella sp	T		+
06201	Hyalella azteca	F		+	96900	Ferrissia sp	F		+
08250	Orconectes (Procericambarus) rusticus	F		+	96930	Laevapex fuscus	MT		+
11119	Plauditus dubius or P. virilis	I		+	97601	Corbicula fluminea	F		+
11120	Baetis flavistriga	F		+	No. Quantitative Taxa: 0		Total Taxa; 48		
11130	Baetis intercalaris	F		+	No. Qualitative Taxa: 48		ICI: MG		
11200	Callibaetis sp	MT		+	Number of Organisms: 0		Qual EPT: 14		
13400	Stenacron sp	F		+					
13521	Stenonema femoratum	F		+					
13561	Maccaffertium pulchellum	MI		+					
16700	Tricorythodes sp	MI		+					
17200	Caenis sp	F		+					
21200	Calopteryx sp	F		+					
22001	Coenagrionidae	T		+					
22300	Argia sp	F		+					
44501	Corixidae	F		+					
52200	Cheumatopsyche sp	F		+					
52430	Ceratopsyche morosa group	MI		+					
53400	Protoptila sp	I		+					
53800	Hydroptila sp	F		+					
59415	Nectopsyche exquisita	MI		+					
59970	Petrophila sp	MI		+					
67000	Helophorus sp	MT		+					
69400	Stenelmis sp	F		+					
71900	Tipula sp	F		+					
74100	Simulium sp	F		+					
77120	Ablabesmyia mallochi	F		+					
77500	Conchapelopia sp	F		+					
77800	Helopelopia sp	F		+					
78655	Procladius (Holotanypus) sp	MT		+					
80510	Cricotopus (Isocladius) sylvestris group	T		+					
82730	Chironomus (C.) decorus group	T		+					
82820	Cryptochironomus sp	F		+					
83040	Dicrotendipes neomodestus	F		+					
83158	Endochironomus nigricans	MT		+					
83300	Glyptotendipes (G.) sp	MT		+					
84450	Polypedilum (Uresipedilum) flavum	F		+					
84470	Polypedilum (P.) illinoense	T		+					

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/16/2022* RM: **132.60**

Site ID: **SR03** Location: *dst. I-670* Sample:

Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.
01320	Hydra sp	F	16	93900	Elimia sp	MI	+
01801	Turbellaria	F	221 +	96900	Ferrissia sp	F	9
03000	Ectoprocta	F	8	97601	Corbicula fluminea	F	+
03600	Oligochaeta	T	1 +				
08200	Orconectes sp	F	+	No. Quantitative Taxa: 27		Total Taxa; 45	
11130	Baetis intercalaris	F	317 +	No. Qualitative Taxa: 35		ICI: 34	
11200	Callibaetis sp	MT	+	Number of Organisms: 4691		Qual EPT: 13	
13000	Leucrocuta sp	MI	+				
13400	Stenacron sp	F	89 +				
13521	Stenonema femoratum	F	52 +				
13570	Maccaffertium terminatum	MI	55 +				
16700	Tricorythodes sp	MI	138 +				
22300	Argia sp	F	9 +				
50315	Chimarra obscura	MI	+				
51206	Cynellus fraternus	F	2				
52200	Cheumatopsyche sp	F	775 +				
52430	Ceratopsyche morosa group	MI	118 +				
52560	Hydropsyche orris	MI	12				
53400	Protoptila sp	I	+				
53800	Hydroptila sp	F	39 +				
59100	Ceraclea sp	MI	+				
59970	Petrophila sp	MI	11 +				
68075	Psephenus herricki	MI	+				
69400	Stenelmis sp	F	+				
74100	Simulium sp	F	+				
77100	Ablabesmyia sp		31				
77120	Ablabesmyia mallochi	F	+				
77800	Helopelopia sp	F	+				
78450	Nilotanypus fimbriatus	F	48				
80310	Cardiocladius obscurus	MI	+				
80420	Cricotopus (C.) bicinctus	T	62 +				
81240	Nanocladius (N.) distinctus	MT	31				
82880	Cryptotendipes sp	F	+				
83040	Dicrotendipes neomodestus	F	31 +				
83300	Glyptotendipes (G.) sp	MT	92 +				
83400	Harnischia sp	F	31				
84450	Polypedilum (Uresipedilum) flavum	F	1815 +				
84540	Polypedilum (Tripodura) scalaenum group	F	+				
85625	Rheotanytarsus sp	F	677 +				
85800	Tanytarsus sp	F	+				
85840	Tanytarsus sepp	F	+				
87540	Hemerodromia sp	F	1				

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/16/2022* RM: **132.10**

Site ID: **SR04** Location: *dst. Olentangy Riveer* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		94 +	78655	Procladius (Holotanypus) sp	MT		+
03000	Ectoprocta	F		3	80410	Cricotopus (C.) sp	F		+
03600	Oligochaeta	T		+	80420	Cricotopus (C.) bicinctus	T		+
04664	Helobdella stagnalis	T		+	81240	Nanocladius (N.) distinctus	MT		19
04930	Erpobdella sp	MT		+	82730	Chironomus (C.) decorus group	T		+
05800	Caecidotea sp	T		+	82820	Cryptochironomus sp	F		+
06201	Hyalella azteca	F		+	83040	Dicrotendipes neomodestus	F		19 +
08601	Hydrachnidia	F		8	83158	Endochironomus nigricans	MT		+
11120	Baetis flavistriga	F		417 +	83300	Glyptotendipes (G.) sp	MT		19 +
11130	Baetis intercalaris	F		+	83400	Harnischia sp	F		+
11200	Callibaetis sp	MT		+	84450	Polypedilum (Uresipedilum) flavum	F		1490 +
12200	Isonychia sp	MI		1	84470	Polypedilum (P.) illinoense	T		+
13000	Leucrocuta sp	MI		+	84490	Polypedilum (Cerobregma) ontario	MI		19 +
13400	Stenacron sp	F		53 +	84520	Polypedilum (Tripodura) halterale group	MT		+
13510	Maccaffertium exiguum	MI		5	84540	Polypedilum (Tripodura) scalaenum group	F		+
13570	Maccaffertium terminatum	MI		+	85500	Paratanytarsus sp	F		+
16700	Tricorythodes sp	MI		195 +	85625	Rheotanytarsus sp	F		697 +
22001	Coenagrionidae	T		+	85821	Tanytarsus glabrescens group sp 7	F		+
22300	Argia sp	F		+	87540	Hemerodromia sp	F		48 +
26700	Macromia sp	MI		+	93900	Elimia sp	MI		+
34715	Agnetina flavescens	I		1	95100	Physella sp	T		+
42700	Belostoma sp	T		+	96900	Ferrissia sp	F		+
45400	Trichocorixa sp	MT		+					
52200	Cheumatopsyche sp	F		1731 +					
52430	Ceratopsyche morosa group	MI		446 +					
52560	Hydropsyche orris	MI		2 +	No. Quantitative Taxa:	25	Total Taxa;	64	
52801	Potamyia flava	MI		29	No. Qualitative Taxa:	54	ICI:	40	
53400	Protophila sp	I		+	Number of Organisms:	5404	Qual EPT:	15	
53800	Hydroptila sp	F		8 +					
58505	Helicopsyche borealis	MI		+					
59407	Nectopsyche candida	MI		+					
59415	Nectopsyche exquisita	MI		+					
59970	Petrophila sp	MI		+					
60900	Peltodytes sp	MT		+					
65800	Berosus sp	MT		+					
68075	Psephenus herricki	MI		+					
68601	Ancyronyx variegata	F		1					
68901	Macronychus glabratus	F		1					
69400	Stenelmis sp	F		2 +					
77120	Ablabesmyia mallochi	F		+					
77750	Hayesomyia senata or Thienemannimyia norena	F		+					
78450	Nilotanypus fimbriatus	F		96					

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/20/2022* RM: **130.10**
 Site ID: **SR05** Location: *ust. Greenlawn Dam* Sample:

Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.
01801	Turbellaria	F	65 +				
03600	Oligochaeta	T	256				
04666	Helobdella papillata	MT	+				
04901	Erpobdellidae	MT	+				
06201	Hyalella azteca	F	1 +				
08601	Hydrachnidia	F	+				
11200	Callibaetis sp	MT	+				
13400	Stenacron sp	F	3				
17200	Caenis sp	F	64 +				
22001	Coenagrionidae	T	+				
22300	Argia sp	F	6				
24107	Nasiaeschna pentacantha	MT	+				
27400	Neurocordulia sp	F	+				
43300	Ranatra sp	F	+				
44501	Corixidae	F	+				
51206	Cynellus fraternus	F	1181				
65800	Berosus sp	MT	+				
77140	Ablabesmyia peleensis		314				
78655	Procladius (Holotanypus) sp	MT	+				
83051	Dicrotendipes simpsoni	T	314				
83158	Endochironomus nigricans	MT	+				
83300	Glyptotendipes (G.) sp	MT	38027 +				
84000	Parachironomus sp	MT	+				
84470	Polypedilum (P.) illinoense	T	+				
85800	Tanytarsus sp	F	+				
95100	Physella sp	T	+				

No. Quantitative Taxa: 10 Total Taxa; 26
 No. Qualitative Taxa: 20 ICI: 6
 Number of Organisms: 40231 Qual EPT: 2

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/16/2022* RM: **129.00**

Site ID: **SR06** Location: *dst. Greenlawn Ave.* Sample:

Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.
01801	Turbellaria	F	106 +	83300	Glyptotendipes (G.) sp	MT	9836 +
03000	Ectoprocta	F	1 +	84450	Polypedilum (Uresipedilum) flavum	F	261 +
03451	Urnatella gracilis	MI	27	84540	Polypedilum (Tripodura) scalaenum group	F	+
03600	Oligochaeta	T	24 +	85625	Rheotanytarsus sp	F	+
04666	Helobdella papillata	MT	+	87540	Hemerodromia sp	F	8
04901	Erpobdellidae	MT	+	93200	Hydrobiidae	F	1 +
06700	Crangonyx sp	MT	+	93900	Elimia sp	MI	11 +
08200	Orconectes sp	F	1	95100	Physella sp	T	+
08250	Orconectes (Procericambarus) rusticus	F	+	97601	Corbicula fluminea	F	+
11001	Baetidae		8				
11130	Baetis intercalaris	F	+	No. Quantitative Taxa: 20		Total Taxa; 50	
11650	Proclleon sp (w/ hindwing pads)	MI	+	No. Qualitative Taxa: 45		ICI: G	
13000	Leucrocuta sp	MI	+	Number of Organisms: 10756		Qual EPT: 16	
13400	Stenacron sp	F	+				
13510	Maccaffertium exiguum	MI	+				
13521	Stenonema femoratum	F	+				
13570	Maccaffertium terminatum	MI	26 +				
16700	Tricorythodes sp	MI	41 +				
17200	Caenis sp	F	12 +				
18600	Ephemera sp	MI	+				
22001	Coenagrionidae	T	+				
22300	Argia sp	F	12 +				
26700	Macromia sp	MI	+				
44501	Corixidae	F	+				
51206	Cynellus fraternus	F	99 +				
52200	Cheumatopsyche sp	F	193 +				
52430	Ceratopsyche morosa group	MI	1 +				
52520	Hydropsyche bidens	MI	1				
52560	Hydropsyche orris	MI	+				
53800	Hydroptila sp	F	+				
59407	Nectopsyche candida	MI	+				
59970	Petrophila sp	MI	+				
69400	Stenelmis sp	F	+				
77120	Ablabesmyia mallochi	F	+				
77500	Conchapelopia sp	F	87 +				
77750	Hayesomyia senata or Thienemannimyia norena	F	+				
80420	Cricotopus (C.) bicinctus	T	+				
81240	Nanocladius (N.) distinctus	MT	+				
82730	Chironomus (C.) decorus group	T	+				
82822	Cryptochironomus eminentia	F	+				
83051	Dicrotendipes simpsoni	T	+				

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/13/2022* RM: **127.70**

Site ID: **SR07** Location: *dst. St. Rte. 104* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
00401	Spongillidae	F		+	81240	Nanocladius (N.) distinctus	MT		39
01200	Cordylophora caspia	MT		1	82130	Thienemanniella similis	MI		16
01320	Hydra sp	F		16	82730	Chironomus (C.) decorus group	T		+
01801	Turbellaria	F		1 +	83300	Glyptotendipes (G.) sp	MT		511 +
03073	Lophopodella carteri	MI		+	84040	Parachironomus frequens	F		+
03451	Urnatella gracilis	MI		1	84450	Polypedilum (Uresipedilum) flavum	F		2240 +
03600	Oligochaeta	T		45 +	84470	Polypedilum (P.) illinoense	T		+
04964	Erpobdella microstoma	MT		+	84520	Polypedilum (Tripodura) halterale group	MT		+
05800	Caecidotea sp	T		+	84540	Polypedilum (Tripodura) scalaenum group	F		+
08250	Orconectes (Procericambarus) rusticus	F		+	84888	Xenochironomus xenolabis	F		+
11123	Labiobaetis dardanus	MI		+	85625	Rheotanytarsus sp	F		1415 +
11130	Baetis intercalaris	F		75 +	85800	Tanytarsus sp	F		+
11245	Anafroptilum or Neocoloeon sp. =(Centroptilum sp.)	F		+	87540	Hemerodromia sp	F		2
11651	Proclaeon sp (w/o hindwing pads)	MI		+	93200	Hydrobiidae	F		4
11670	Proclaeon viridoculare	MI		+	93900	Elimia sp	MI		1 +
12200	Isonychia sp	MI		+	99680	Leptodea fragilis	MI		+
13000	Leucrocuta sp	MI		+					
13400	Stenacron sp	F		3 +	No. Quantitative Taxa: 28		Total Taxa; 56		
13510	Maccaffertium exiguum	MI		7 +	No. Qualitative Taxa: 47		ICI: 42		
13561	Maccaffertium pulchellum	MI		61 +	Number of Organisms: 9744		Qual EPT: 19		
13570	Maccaffertium terminatum	MI		48 +					
16700	Tricorythodes sp	MI		54 +					
18100	Anthopotamus sp	MI		+					
22001	Coenagrionidae	T		+					
22300	Argia sp	F		+					
51206	Cyrnellus fraternus	F		68 +					
52200	Cheumatopsyche sp	F		2807 +					
52430	Ceratopsyche morosa group	MI		8 +					
52560	Hydropsyche orris	MI		2093 +					
52570	Hydropsyche simulans	MI		55					
52801	Potamyia flava	MI		58 +					
53400	Protoptila sp	I		+					
59970	Petrophila sp	MI		75 +					
68075	Psephenus herricki	MI		+					
69400	Stenelmis sp	F		1 +					
74100	Simulium sp	F		+					
77120	Ablabesmyia mallochi	F		+					
77130	Ablabesmyia rhamphe group	MT		+					
77750	Hayesomyia senata or Thienemannimyia norena	F		+					
78750	Rheopelopia paramaculipennis	MI		39					

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/13/2022* RM: **127.40**

Site ID: **SR08.2** Location: *ust. Jackson Pike WWTP* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
00401	Spongillidae	F		+	81240	Nanocladius (N.) distinctus	MT		66
01200	Cordylophora caspia	MT		+	82130	Thienemanniella similis	MI		16
01320	Hydra sp	F	16		82730	Chironomus (C.) decorus group	T		+
01801	Turbellaria	F	3	+	82770	Chironomus (C.) riparius group	T		+
03360	Plumatella sp	F		+	82820	Cryptochironomus sp	F		+
03451	Urnatella gracilis	MI	16		83040	Dicrotendipes neomodestus	F		100
03600	Oligochaeta	T	65	+	83050	Dicrotendipes lucifer	MT		233
04660	Helobdella sp	MT		+	83051	Dicrotendipes simpsoni	T		199
04666	Helobdella papillata	MT		+	83158	Endochironomus nigricans	MT		+
05800	Caecidotea sp	T		+	83300	Glyptotendipes (G.) sp	MT		2226
06700	Crangonyx sp	MT		+	84450	Polypedilum (Uresipedilum) flavum	F		266
11130	Baetis intercalaris	F	18		84470	Polypedilum (P.) illinoense	T		+
11200	Callibaetis sp	MT		+	84520	Polypedilum (Tripodura) halterale group	MT		+
11670	Proclleon viridoculare	MI		+	84540	Polypedilum (Tripodura) scalaenum group	F		+
13400	Stenacron sp	F	2	+	85230	Cladotanytarsus mancus group	F		+
13521	Stenonema femoratum	F		+	85625	Rheotanytarsus sp	F		199
13570	Maccaffertium terminatum	MI	3	+	87501	Empididae	F		2
16700	Tricorythodes sp	MI	30	+	93200	Hydrobiidae	F		+
17200	Caenis sp	F	42	+	93900	Elimia sp	MI		8
18100	Anthopotamus sp	MI		+	96930	Laevapex fuscus	MT		+
18600	Ephemera sp	MI		+	97601	Corbicula fluminea	F		24
22001	Coenagrionidae	T		+	97710	Dreissena polymorpha	F		+
22300	Argia sp	F	1	+					
24700	Dromogomphus sp	F		+					
27400	Neurocordulia sp	F		+					
42700	Belostoma sp	T		+	No. Quantitative Taxa:	33	Total Taxa;		64
51206	Cyrnellus fraternus	F	148	+	No. Qualitative Taxa:	47	ICI:		34
52200	Cheumatopsyche sp	F	731	+	Number of Organisms:	4788	Qual EPT:		13
52430	Ceratopsyche morosa group	MI	3						
52560	Hydropsyche orris	MI	95						
52570	Hydropsyche simulans	MI	3						
52801	Potamyia flava	MI	7						
53800	Hydroptila sp	F	34	+					
59415	Nectopsyche exquisita	MI		+					
60900	Peltodytes sp	MT		+					
68075	Psephenus herricki	MI		+					
69400	Stenelmis sp	F	1	+					
77120	Ablabesmyia mallochi	F		+					
77130	Ablabesmyia rhamphe group	MT	166	+					
77750	Hayesomyia senata or Thienemannimyia norena	F	33	+					
78140	Labrundinia pilosella	F	16						
80360	Corynoneura floridaensis	MI	16						

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/13/2022* RM: **127.00**

Site ID: **SRJPMZ** Location: *Jackson Pike WWTP mixing zone* Sample:

Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.
00401	Spongillidae	F	+				
01320	Hydra sp	F	32	No. Quantitative Taxa: 21 Total Taxa; 37			
01801	Turbellaria	F	20 +	No. Qualitative Taxa: 28 ICI: 10			
01900	Nemertea	F	51	Number of Organisms: 12720 Qual EPT: 2			
03600	Oligochaeta	T	8808 +				
04664	Helobdella stagnalis	T	1 +				
04666	Helobdella papillata	MT	+				
04901	Erpobdellidae	MT	+				
04964	Erpobdella microstoma	MT	+				
05800	Caecidotea sp	T	39 +				
06700	Crangonyx sp	MT	+				
13500	Maccaffertium sp	MI	1				
17200	Caenis sp	F	+				
22001	Coenagrionidae	T	1 +				
22300	Argia sp	F	+				
24107	Nasiaeschna pentacantha	MT	+				
43300	Ranatra sp	F	+				
44501	Corixidae	F	+				
51206	Cynellus fraternus	F	37				
52430	Ceratopsyche morosa group	MI	1				
53800	Hydroptila sp	F	74 +				
65800	Berosus sp	MT	+				
77120	Ablabesmyia mallochii	F	33 +				
77130	Ablabesmyia rhamphe group	MT	+				
80510	Cricotopus (Isocladius) sylvestris group	T	99 +				
81231	Nanocladius (N.) crassicornus or N. (N.) "rectinervis"	F	33				
82730	Chironomus (C.) decorus group	T	+				
82770	Chironomus (C.) riparius group	T	99 +				
83040	Dicrotendipes neomodestus	F	+				
83050	Dicrotendipes lucifer	MT	33				
83300	Glyptotendipes (G.) sp	MT	3205 +				
84300	Phaenopsectra obediens group	F	66				
84470	Polypedilum (P.) illinoense	T	+				
93200	Hydrobiidae	F	1 +				
95100	Physella sp	T	1 +				
96801	Ancylidae	F	85				
96930	Laevapex fuscus	MT	+				

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/14/2022* RM: **126.50**

Site ID: **SR08** Location: *dst. Jackson Pike WWTP* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01200	Cordylophora caspia	MT		1	82730	Chironomus (C.) decorus group	T		+
01801	Turbellaria	F		8 +	82770	Chironomus (C.) riparius group	T		+
03360	Plumatella sp	F		1	83040	Dicrotendipes neomodestus	F		+
03600	Oligochaeta	T		80 +	83300	Glyptotendipes (G.) sp	MT	1376	+
04687	Placobdella parasitica	MT		+	84000	Parachironomus sp	MT		+
04964	Erpobdella microstoma	MT		+	84040	Parachironomus frequens	F	106	
05800	Caecidotea sp	T		+	84300	Phaenopsectra obediens group	F		+
06700	Crangonyx sp	MT		+	84450	Polypedilum (Uresipedilum) flavum	F	4976	+
08601	Hydrachnidia	F		+	84470	Polypedilum (P.) illinoense	T		+
11130	Baetis intercalaris	F	173	+	84520	Polypedilum (Tripodura) halterale group	MT		+
11200	Callibaetis sp	MT		+	84700	Stenochironomus sp	F	106	
11670	Proclleon viridoculare	MI		+	85625	Rheotanytarsus sp	F	1906	+
13400	Stenacron sp	F		+	85800	Tanytarsus sp	F		+
13500	Maccaffertium sp	MI		+	87501	Empididae	F		1
13510	Maccaffertium exiguum	MI		2	93200	Hydrobiidae	F		+
13561	Maccaffertium pulchellum	MI		9	93900	Elimia sp	MI		+
13570	Maccaffertium terminatum	MI		27 +	95100	Physella sp	T		+
16700	Tricorythodes sp	MI		8 +	96900	Ferrissia sp	F		+
17200	Caenis sp	F		+					
22001	Coenagrionidae	T		+					
22300	Argia sp	F		+	No. Quantitative Taxa:	26	Total Taxa;	59	
42700	Belostoma sp	T		+	No. Qualitative Taxa:	44	ICI:	40	
45400	Trichocorixa sp	MT		+	Number of Organisms:	18031	Qual EPT:	11	
51206	Cynellus fraternus	F	48	+					
52200	Cheumatopsyche sp	F	5936	+					
52430	Ceratopsyche morosa group	MI	89						
52521	Hydropsyche bidens or H. orris	MI	87						
52560	Hydropsyche orris	MI	2385						
52570	Hydropsyche simulans	MI	519						
52580	Hydropsyche valanis	MI	1						
52801	Potamyia flava	MI	5						
53800	Hydroptila sp	F		+					
59970	Petrophila sp	MI	43	+					
69400	Stenelmis sp	F		+					
77120	Ablabesmyia mallochi	F		+					
77130	Ablabesmyia rhamphe group	MT		+					
77750	Hayesomyia senata or Thienemannimyia norena	F	106						
78655	Procladius (Holotanypus) sp	MT		+					
80410	Cricotopus (C.) sp	F		+					
80510	Cricotopus (Isocladius) sylvestris group	T		+					
82130	Thienemanniella similis	MI	32						

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/14/2022* RM: **125.40**

Site ID: **SR09** Location: *dst. American Aggregates* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01200	Cordylophora caspia	MT		1	78750	Rheopelopia paramaculipennis	MI		+
01320	Hydra sp	F		64	80410	Cricotopus (C.) sp	F		138
01801	Turbellaria	F		1 +	81231	Nanocladius (N.) crassicornus or N. (N.) "rectinervis"	F		69
03360	Plumatella sp	F		3 +	82130	Thienemanniella similis	MI		32 +
03600	Oligochaeta	T		482	82730	Chironomus (C.) decorus group	T		+
04666	Helobdella papillata	MT		+	82820	Cryptochironomus sp	F		+
04964	Erpobdella microstoma	MT		+	83040	Dicrotendipes neomodestus	F		+
05800	Caecidotea sp	T		+	83050	Dicrotendipes lucifer	MT		207
06700	Crangonyx sp	MT		+	83300	Glyptotendipes (G.) sp	MT		414 +
08250	Orconectes (Procericambarus) rusticus	F		+	84300	Phaenopsectra obediens group	F		+
11130	Baetis intercalaris	F		3 +	84450	Polypedilum (Uresipedilum) flavum	F		2000 +
11650	Proclleon sp (w/ hindwing pads)	MI		+	84470	Polypedilum (P.) illinoense	T		+
12200	Isonychia sp	MI		+	84540	Polypedilum (Tripodura) scalaenum group	F		+
13400	Stenacron sp	F		1 +	85625	Rheotanytarsus sp	F		2965 +
13510	Maccaffertium exiguum	MI		1	87540	Hemerodromia sp	F		22
13570	Maccaffertium terminatum	MI		18 +	93200	Hydrobiidae	F		+
16700	Tricorythodes sp	MI		130 +	93900	Elimia sp	MI		3 +
17200	Caenis sp	F		+	95100	Physella sp	T		+
18100	Anthopotamus sp	MI		+	97601	Corbicula fluminea	F		1
18600	Ephemera sp	MI		+					
21300	Hetaerina sp	F		1 +					
22001	Coenagrionidae	T		+	No. Quantitative Taxa:	30	Total Taxa:	60	
22300	Argia sp	F		1 +	No. Qualitative Taxa:	50	ICI:	40	
24900	Gomphus sp	F		+	Number of Organisms:	13048	Qual EPT:	17	
26700	Macromia sp	MI		+					
43300	Ranatra sp	F		+					
51206	Cyrnellus fraternus	F		74 +					
52200	Cheumatopsyche sp	F		2869 +					
52430	Ceratopsyche morosa group	MI		+					
52560	Hydropsyche orris	MI		3447 +					
52570	Hydropsyche simulans	MI		30 +					
52801	Potamyia flava	MI		16 +					
53400	Protophila sp	I		+					
53800	Hydroptila sp	F		6 +					
59970	Petrophila sp	MI		17 +					
67800	Tropisternus sp	T		+					
69400	Stenelmis sp	F		+					
77120	Ablabesmyia mallochi	F		+					
77130	Ablabesmyia rhamphe group	MT		+					
77750	Hayesomyia senata or Thienemannimyia norena	F		+					
78450	Nilotanypus fimbriatus	F		32					

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/14/2022* RM: **124.50**

Site ID: **SR10** Location: *dst. I-270* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		1	79020	Tanytus neopunctipennis	T		+
03121	Paludicella articulata	MI		+	80410	Cricotopus (C.) sp	F		+
03360	Plumatella sp	F		2 +	81231	Nanocladius (N.) crassicornus or N. (N.) "rectinervis"	F		+
03600	Oligochaeta	T		433 +	82130	Thienemanniella similis	MI		64 +
04615	Actinobdella inequiannulata	MT		+	82730	Chironomus (C.) decorus group	T		+
04964	Erpobdella microstoma	MT		+	83050	Dicrotendipes lucifer	MT		60
05800	Caecidotea sp	T		+	83300	Glyptotendipes (G.) sp	MT		781 +
06700	Crangonyx sp	MT		+	84010	Parachironomus "abortivus" (sensu Simpson & Bode, 1980)	MT		+
08250	Orconectes (Procericambarus) rusticus	F		+	84300	Phaenopsectra obediens group	F		+
11121	Labiobaetis sp	MI		+	84450	Polypedilum (Uresipedilum) flavum	F		2223 +
11130	Baetis intercalaris	F		42 +	84470	Polypedilum (P.) illinoense	T		+
11200	Callibaetis sp	MT		+	84540	Polypedilum (Tripodura) scalaenum group	F		+
12200	Isonychia sp	MI		2	85625	Rheotanytarsus sp	F		3964 +
13400	Stenacron sp	F		3 +	85840	Tanytarsus sepp	F		+
13510	Maccaffertium exiguum	MI		52	87501	Empididae	F		16 +
13561	Maccaffertium pulchellum	MI		3	92615	Cipangopaludina japonica	MT		+
13570	Maccaffertium terminatum	MI		166 +	93900	Elimia sp	MI		10 +
16700	Tricorythodes sp	MI		80 +	96900	Ferrissia sp	F		+
17200	Caenis sp	F		+	97710	Dreissena polymorpha	F		+
22001	Coenagrionidae	T		+	99400	Quadrula quadrula	MI		+
22300	Argia sp	F		+					
24107	Nasiaeschna pentacantha	MT		+					
26700	Macromia sp	MI		1 +					
43300	Ranatra sp	F		+					
51206	Cynellus fraternus	F		193 +					
52200	Cheumatopsyche sp	F		3611 +					
52430	Ceratopsyche morosa group	MI		1					
52560	Hydropsyche orris	MI		3768 +					
52570	Hydropsyche simulans	MI		33 +					
52801	Potamyia flava	MI		12 +					
53400	Protoptila sp	I		+					
59407	Nectopsyche candida	MI		+					
59970	Petrophila sp	MI		30 +					
63900	Laccophilus sp	T		+					
65800	Berosus sp	MT		+					
68901	Macronychus glabratus	F		+					
69400	Stenelmis sp	F		2 +					
77120	Ablabesmyia mallochi	F		+					
77130	Ablabesmyia rhamphe group	MT		60 +					
77750	Hayesomyia senata or Thienemannimyia norena	F		+					
78655	Procladius (Holotanypus) sp	MT		+					

No. Quantitative Taxa: 27 Total Taxa; 61
 No. Qualitative Taxa: 55 ICI: 40
 Number of Organisms: 15613 Qual EPT: 13

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/27/2022* RM: **120.10**

Site ID: **SR11** Location: *at SR 665* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01200	Cordylophora caspia	MT		1	69400	Stenelmis sp	F		+
01801	Turbellaria	F		11 +	71900	Tipula sp	F		+
03360	Plumatella sp	F		+	74100	Simulium sp	F		4 +
03600	Oligochaeta	T		40	77120	Ablabesmyia mallochi	F		+
04660	Helobdella sp	MT		1	77130	Ablabesmyia rhamphe group	MT		+
04664	Helobdella stagnalis	T		+	77750	Hayesomyia senata or Thienemannimyia norena	F		369 +
05800	Caecidotea sp	T		1 +	81231	Nanocladius (N.) crassicornus or N. (N.) "rectinervis"	F		46
06201	Hyalella azteca	F		+	81825	Rheocricotopus (Psilocricotopus) robacki	F		46
06700	Crangonyx sp	MT		+	82130	Thienemanniella similis	MI		32
08250	Orconectes (Procericambarus) rusticus	F		+	82710	Chironomus (C.) sp	MT		+
11119	Plauditus dubius or P. virilis	I		+	82730	Chironomus (C.) decorus group	T		+
11130	Baetis intercalaris	F		176 +	82885	Cryptotendipes pseudotener	F		+
11650	Proclleon sp (w/ hindwing pads)	MI		+	83040	Dicrotendipes neomodestus	F		+
11670	Proclleon viridoculare	MI		+	83300	Glyptotendipes (G.) sp	MT		554 +
12200	Isonychia sp	MI		18 +	84040	Parachironomus frequens	F		106
13000	Leucrocuta sp	MI		+	84450	Polypedilum (Uresipedilum) flavum	F		369 +
13400	Stenacron sp	F		+	84470	Polypedilum (P.) illinoense	T		+
13510	Maccaffertium exiguum	MI		215 +	85625	Rheotanytarsus sp	F		3047 +
13521	Stenonema femoratum	F		+	87540	Hemerodromia sp	F		147 +
13570	Maccaffertium terminatum	MI		384 +	93900	Elimia sp	MI		1 +
16700	Tricorythodes sp	MI		43 +	96900	Ferrissia sp	F		+
17200	Caenis sp	F		+	97601	Corbicula fluminea	F		+
18100	Anthopotamus sp	MI		+	97710	Dreissena polymorpha	F		+
21300	Hetaerina sp	F		+	98600	Sphaerium sp	F		+
22001	Coenagrionidae	T		+	99320	Tritogonia verrucosa	MI		+
22300	Argia sp	F		3 +	99400	Quadrula quadrula	MI		+
23909	Boyeria vinosa	F		+	99640	Truncilla donaciformis	MI		+
34715	Agnatina flavescens	I		+	99680	Leptodea fragilis	MI		+
44501	Corixidae	F		+	99700	Potamilus alatus	MI		+
51206	Cyrnellus fraternus	F		10	99720	Potamilus ohioensis	MI		+
52200	Cheumatopsyche sp	F		3423 +	99890	Epioblasma obliquata obliquata			+
52430	Ceratopsyche morosa group	MI		11					
52560	Hydropsyche orris	MI		3561 +					
52570	Hydropsyche simulans	MI		558 +					
52580	Hydropsyche valanis	MI		+	No. Quantitative Taxa:	29	Total Taxa;	73	
52801	Potamyia flava	MI		209 +	No. Qualitative Taxa:	63	ICI:	50	
53400	Protophila sp	I		+	Number of Organisms:	13402	Qual EPT:	22	
59407	Nectopsyche candida	MI		+					
59415	Nectopsyche exquisita	MI		+					
59500	Oecetis sp	F		16					
59970	Petrophila sp	MI		+					
60900	Peltodytes sp	MT		+					

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: Coll. Date: *09/27/2022* RM: **118.20**

Site ID: **SRCSMZ** Location: Sample:

Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.
01320	Hydra sp	F	32				
01801	Turbellaria	F	76 +				
01900	Nemertea	F	17				
03360	Plumatella sp	F	25				
03600	Oligochaeta	T	434 +				
04664	Helobdella stagnalis	T	+				
04901	Erpobdellidae	MT	+				
05800	Caecidotea sp	T	1 +				
06700	Crangonyx sp	MT	+				
13400	Stenacron sp	F	8				
13570	Maccaffertium terminatum	MI	2 +				
16700	Tricorythodes sp	MI	9				
22001	Coenagrionidae	T	6 +				
22300	Argia sp	F	8 +				
43300	Ranatra sp	F	+				
45400	Trichocorixa sp	MT	+				
51206	Cynellus fraternus	F	54				
59407	Nectopsyche candida	MI	1				
82730	Chironomus (C.) decorus group	T	+				
82822	Cryptochironomus eminentia	F	+				
83040	Dicrotendipes neomodestus	F	+				
83300	Glyptotendipes (G.) sp	MT	6560 +				
84470	Polypedilum (P.) illinoense	T	+				
95100	Physella sp	T	11				
96900	Ferrissia sp	F	218				

No. Quantitative Taxa: 16 Total Taxa; 25

No. Qualitative Taxa: 16 ICI: 0

Number of Organisms: 7462 Qual EPT: 0

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/29/2022* RM: **118.00**

Site ID: **SR12** Location: *dst. Southerly WWTP* Sample:

Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.
01801	Turbellaria	F	+	83300	Glyptotendipes (G.) sp	MT	949 +
03000	Ectoprocta	F	+	84450	Polypedilum (Uresipedilum) flavum	F	759 +
03600	Oligochaeta	T	24 +	84470	Polypedilum (P.) illinoense	T	+
04685	Placobdella ornata	MT	+	85625	Rheotanytarsus sp	F	3037 +
05800	Caecidotea sp	T	+	87540	Hemerodromia sp	F	16
06700	Crangonyx sp	MT	+	93900	Elimia sp	MI	34 +
11130	Baetis intercalaris	F	263 +	96900	Ferrissia sp	F	1 +
12200	Isonychia sp	MI	49	98600	Sphaerium sp	F	+
13400	Stenacron sp	F	1 +				
13510	Maccaffertium exiguum	MI	1	No. Quantitative Taxa: 28		Total Taxa; 50	
13570	Maccaffertium terminatum	MI	283 +	No. Qualitative Taxa: 42		ICI: 44	
16700	Tricorythodes sp	MI	8 +	Number of Organisms: 10417		Qual EPT: 18	
17200	Caenis sp	F	+				
18100	Anthopotamus sp	MI	+				
21300	Hetaerina sp	F	+				
22001	Coenagrionidae	T	+				
22300	Argia sp	F	+				
23905	Boyeria grafiana	X MI	+				
24107	Nasiaeschna pentacantha	MT	+				
43300	Ranatra sp	F	+				
51206	Cyrnellus fraternus	F	+				
52200	Cheumatopsyche sp	F	2239 +				
52430	Ceratopsyche morosa group	MI	142 +				
52520	Hydropsyche bidens	MI	144 +				
52560	Hydropsyche orris	MI	809 +				
52570	Hydropsyche simulans	MI	530 +				
52580	Hydropsyche valanis	MI	72 +				
52801	Potamyia flava	MI	215 +				
53400	Protophila sp	I	+				
53800	Hydroptila sp	F	+				
59300	Mystacides sp	MI	+				
59407	Nectopsyche candida	MI	+				
59970	Petrophila sp	MI	1 +				
69400	Stenelmis sp	F	1 +				
74501	Ceratopogonidae	T	1				
77500	Conchapelopia sp	F	316				
77750	Hayesomyia senata or Thienemannimyia norena	F	316				
78450	Nilotanypus fimbriatus	F	16				
80420	Cricotopus (C.) bicinctus	T	+				
81240	Nanocladius (N.) distinctus	MT	127				
82730	Chironomus (C.) decorus group	T	+				
83040	Dicrotendipes neomodestus	F	63 +				

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: *Scioto River* Coll. Date: *09/27/2022* RM: **116.80**

Site ID: **SR13** Location: *dst. Big Walnut Creek* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		32	78599	Pentaneura sp	F		+
03000	Ectoprocta	F		2	80310	Cardiocladius obscurus	MI		+
03600	Oligochaeta	T		+	80410	Cricotopus (C.) sp	F		104
04930	Erpobdella sp	MT		+	80420	Cricotopus (C.) bicinctus	T		35
05800	Caecidotea sp	T		+	80430	Cricotopus (C.) tremulus group	MT		+
08200	Orconectes sp	F		+	81240	Nanocladius (N.) distinctus	MT		104
11121	Labiobaetis sp	MI		+	82100	Thienemanniella sp			69
11130	Baetis intercalaris	F		263	82730	Chironomus (C.) decorus group	T		35
11620	Paracloeodes minutus	MI		+	82820	Cryptochironomus sp	F		+
11670	Proclaeon viridoculare	MI		+	83040	Dicrotendipes neomodestus	F		+
12200	Isonychia sp	MI		83	83300	Glyptotendipes (G.) sp	MT		207
13000	Leucrocota sp	MI		+	84040	Parachironomus frequens	F		+
13400	Stenacron sp	F		1	84300	Phaenopsectra obediens group	F		+
13510	Maccaffertium exiguum	MI		1	84450	Polypedilum (Uresipedilum) flavum	F		449
13521	Stenonema femoratum	F		+	84470	Polypedilum (P.) illinoense	T		+
13570	Maccaffertium terminatum	MI		885	84520	Polypedilum (Tripodura) halterale group	MT		+
16700	Tricorythodes sp	MI		3	84540	Polypedilum (Tripodura) scalaenum group	F		+
17200	Caenis sp	F		+	84700	Stenochironomus sp	F		69
18100	Anthopotamus sp	MI		+	84960	Pseudochironomus sp	F		+
21300	Hetaerina sp	F		+	85625	Rheotanytarsus sp	F		1726
22001	Coenagrionidae	T		+	87540	Hemerodromia sp	F		1
45400	Trichocorixa sp	MT		+	93900	Elimia sp	MI		+
51206	Cynnellus fraternus	F		33	95100	Physella sp	T		+
52200	Cheumatopsyche sp	F		1446	97601	Corbicula fluminea	F		+
52430	Ceratopsyche morosa group	MI		40	98001	Pisidiidae			+
52520	Hydropsyche bidens	MI		120	99240	Lasmigona complanata	MI		+
52560	Hydropsyche orris	MI		357	99380	Quadrula pustulosa pustulosa	MI		+
52570	Hydropsyche simulans	MI		512	99400	Quadrula quadrula	MI		+
52580	Hydropsyche valanis	MI		1	99640	Truncilla donaciformis	MI		+
52801	Potamyia flava	MI		157	99700	Potamilus alatus	MI		+
53400	Protoptila sp	I		+	99780	Ligumia recta	MI		+
53800	Hydroptila sp	F		1					
59407	Nectopsyche candida	MI		+					
59970	Petrophila sp	MI		32					
67800	Tropisternus sp	T		+	No. Quantitative Taxa: 30				Total Taxa; 73
68708	Dubiraphia vittata group	F		+	No. Qualitative Taxa: 66				ICI: 48
69400	Stenelmis sp	F		+	Number of Organisms: 7045				Qual EPT: 21
72900	Culex sp	T		+					
74100	Simulium sp	F		+					
77120	Ablabesmyia mallochi	F		+					
77500	Conchapelopia sp	F		104					
77750	Hayesomyia senata or Thienemannimyia norena	F		173					

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/27/2022* RM: **116.00**

Site ID: **SR14** Location: *dst. historic Pickaway Power Plant lot* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		2 +	69400	Stenelmis sp	F		19 +
03600	Oligochaeta	T		+	74100	Simulium sp	F		36 +
04664	Helobdella stagnalis	T		+	77750	Hayesomyia senata or Thienemannimyia norena	F		35
04666	Helobdella papillata	MT		+	80410	Cricotopus (C.) sp	F		+
05800	Caecidotea sp	T		+	81231	Nanocladius (N.) crassicornus or N. (N.) "rectinervis"	F		71
06700	Crangonyx sp	MT		+	81825	Rheocricotopus (Psilocricotopus) robacki	F		+
08601	Hydrachnidia	F		32 +	82100	Thienemanniella sp			64
11010	Acentrella sp	I		+	82220	Tvetenia discoloripes group	MI		71
11118	Plautidius dubius	MI		4	82730	Chironomus (C.) decorus group	T		+
11130	Baetis intercalaris	F		456 +	83040	Dicretendipes neomodestus	F		+
11150	Labiobaetis propinquus	MI		+	83300	Glyptotendipes (G.) sp	MT		+
11670	Proclleon viridoculare	MI		+	84000	Parachironomus sp	MT		+
12200	Isonychia sp	MI		101 +	84450	Polypedilum (Uresipedilum) flavum	F		425 +
13000	Leucrocuta sp	MI		+	84470	Polypedilum (P.) illinoense	T		+
13100	Nixe sp	MI		+	84540	Polypedilum (Tripodura) scalaenum group	F		+
13400	Stenacron sp	F		+	85625	Rheotanytarsus sp	F		2795 +
13510	Maccaffertium exiguum	MI		295	85821	Tanytarsus glabrescens group sp 7	F		35
13521	Stenonema femoratum	F		+	87540	Hemerodromia sp	F		17
13570	Maccaffertium terminatum	MI		204 +	93900	Elimia sp	MI		+
16700	Tricorythodes sp	MI		+	95100	Physella sp	T		+
17200	Caenis sp	F		+	97601	Corbicula fluminea	F		+
18100	Anthopotamus sp	MI		+	97710	Dreissena polymorpha	F		+
22001	Coenagrionidae	T		+	98600	Sphaerium sp	F		+
22300	Argia sp	F		+	99380	Quadrula pustulosa pustulosa	MI		+
23909	Boyeria vinosa	F		+	99400	Quadrula quadrula	MI		+
24107	Nasiaeschna pentacantha	MT		+					
34715	Agnatina flavescens	I		1 +					
44501	Corixidae	F		+					
50315	Chimarra obscura	MI		8					
51206	Cyrnellus fraternus	F		+					
52200	Cheumatopsyche sp	F		2594 +	No. Quantitative Taxa:	27	Total Taxa;	68	
52430	Ceratopsyche morosa group	MI		168 +	No. Qualitative Taxa:	57	ICI:	52	
52520	Hydropsyche bidens	MI		88	Number of Organisms:	9291	Qual EPT:	22	
52560	Hydropsyche orris	MI		762 +					
52570	Hydropsyche simulans	MI		763 +					
52801	Potamyia flava	MI		241 +					
53501	Hydroptilidae	F		+					
59407	Nectopsyche candida	MI		+					
59720	Triadenodes ignitus	MI		+					
59970	Petrophila sp	MI		2 +					
65800	Berosus sp	MT		+					
68075	Psephenus herricki	MI		+					
68901	Macronychus glabratus	F		2					

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: *Scioto River* Coll. Date: *09/25/2022* RM: **114.00**

Site ID: **SR15** Location: *dst. SR. 762* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		12	78655	Procladius (Holotanypus) sp	MT		+
01900	Nemertea	F		1	80410	Cricotopus (C.) sp	F		+
03600	Oligochaeta	T		+	81231	Nanocladius (N.) crassicornus or N. (N.) "rectinervis"	F		48
05800	Caecidotea sp	T		+	81240	Nanocladius (N.) distinctus	MT		48
06700	Crangonyx sp	MT		+	82100	Thienemanniella sp			32
11130	Baetis intercalaris	F		307 +	82710	Chironomus (C.) sp	MT		+
11620	Paracloeodes minutus	MI		+	82820	Cryptochironomus sp	F		+
11670	Proclleon viridoculare	MI		+	83300	Glyptotendipes (G.) sp	MT		190 +
12200	Isonychia sp	MI		423 +	84040	Parachironomus frequens	F		+
13400	Stenacron sp	F		+	84300	Phaenopsectra obediens group	F		+
13510	Maccaffertium exiguum	MI		383 +	84450	Polypedilum (Uresipedilum) flavum	F		475 +
13570	Maccaffertium terminatum	MI		232 +	84470	Polypedilum (P.) illinoense	T		+
13590	Maccaffertium vicarium	MI		74	85625	Rheotanytarsus sp	F		3802
16700	Tricorythodes sp	MI		1 +	85800	Tanytarsus sp	F		+
17200	Caenis sp	F		+	85840	Tanytarsus sepp	F		+
18100	Anthopotamus sp	MI		+	87540	Hemerodromia sp	F		40
21300	Hetaerina sp	F		+	93900	Elimia sp	MI		1 +
22001	Coenagrionidae	T		+	95100	Physella sp	T		+
22300	Argia sp	F		+	96900	Ferrissia sp	F		+
23909	Boyeria vinosa	F		+	97601	Corbicula fluminea	F		+
24800	Gomphurus sp	MI		+	98200	Pisidium sp	MT		1
25010	Hagenius brevistylus	F		+	98600	Sphaerium sp	F		+
34715	Agnatina flavescens	I		1 +	99380	Quadrula pustulosa pustulosa	MI		+
50315	Chimarra obscura	MI		1 +	99400	Quadrula quadrula	MI		+
52200	Cheumatopsyche sp	F		1134 +	99580	Obliquaria reflexa	MI		+
52430	Ceratopsyche morosa group	MI		85 +	99640	Truncilla donaciformis	MI		+
52520	Hydropsyche bidens	MI		1 +	99680	Leptodea fragilis	MI		+
52560	Hydropsyche orris	MI		919 +	99700	Potamilus alatus	MI		+
52570	Hydropsyche simulans	MI		1102 +	99780	Ligumia recta	MI		+
52801	Potamyia flava	MI		762 +	99880	Lampsilis cardium	MI		+
53400	Protoptila sp	I		+					
54160	Ochrotrichia sp	MI		2 +					
59407	Nectopsyche candida	MI		+	No. Quantitative Taxa: 29				Total Taxa; 72
59970	Petrophila sp	MI		+	No. Qualitative Taxa: 63				ICI: 52
68130	Helichus sp	F		+	Number of Organisms: 10387				Qual EPT: 21
68601	Ancyronyx variegata	F		+					
68901	Macronychus glabratus	F		+					
69400	Stenelmis sp	F		4 +					
74100	Simulium sp	F		68 +					
77120	Ablabesmyia mallochi	F		+					
77130	Ablabesmyia rhamphe group	MT		+					
77750	Hayesomyia senata or Thienemannimyia norena	F		238 +					

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/18/2022* RM: **109.35**

Site ID: **SR16** Location: *dst. OH-316* Sample:

Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.
01801	Turbellaria	F	100 +	78450	Nilotanypus fimbriatus	F	28
01900	Nemertea	F	1	80410	Cricotopus (C.) sp	F	+
03600	Oligochaeta	T	+	80420	Cricotopus (C.) bicinctus	T	+
05800	Caecidotea sp	T	1 +	82220	Tvetenia discoloripes group	MI	28
06700	Crangonyx sp	MT	+	83300	Glyptotendipes (G.) sp	MT	413 +
08250	Orconectes (Procericambarus) rusticus	F	+	84040	Parachironomus frequens	F	+
11123	Labiobaetis dardanus	MI	+	84450	Polypedilum (Uresipedilum) flavum	F	358 +
11130	Baetis intercalaris	F	178 +	84520	Polypedilum (Tripodura) halterale group	MT	+
11620	Paracloeodes minutus	MI	+	84540	Polypedilum (Tripodura) scalaenum group	F	+
12200	Isonychia sp	MI	424 +	84612	Saetheria tylus	F	+
13100	Nixe sp	MI	+	85625	Rheotanytarsus sp	F	1846 +
13400	Stenacron sp	F	+	85625	Rheotanytarsus sp	F	+
13510	Maccaffertium exiguum	MI	548 +	85840	Tanytarsus sepp	F	28
13550	Maccaffertium mexicanum integrum	MI	4	87501	Empididae	F	1
13570	Maccaffertium terminatum	MI	268 +	93900	Elimia sp	MI	+
13590	Maccaffertium vicarium	MI	8	95100	Physella sp	T	+
16700	Tricorythodes sp	MI	98 +	97601	Corbicula fluminea	F	2 +
18100	Anthopotamus sp	MI	+	98600	Sphaerium sp	F	+
21300	Hetaerina sp	F	+	99380	Quadrula pustulosa pustulosa	MI	+
22300	Argia sp	F	+	99580	Obliquaria reflexa	MI	+
27001	Corduliidae		+	99680	Leptodea fragilis	MI	+
34605	Perlinella drymo	MI	+	99880	Lampsilis cardium	MI	+
34715	Agnetina flavescens	I	+				
48410	Corydalus cornutus	MI	1	No. Quantitative Taxa: 33		Total Taxa; 62	
50315	Chimarra obscura	MI	1	No. Qualitative Taxa: 51		ICI: 54	
52200	Cheumatopsyche sp	F	1085 +	Number of Organisms: 7515		Qual EPT: 20	
52430	Ceratopsyche morosa group	MI	133 +				
52520	Hydropsyche bidens	MI	130 +				
52560	Hydropsyche orris	MI	232 +				
52570	Hydropsyche simulans	MI	617 +				
52801	Potamyia flava	MI	695 +				
53201	Glossosomatidae	MI	+				
53501	Hydroptilidae	F	8				
59407	Nectopsyche candida	MI	16 +				
68130	Helichus sp	F	+				
68601	Ancyronyx variegata	F	2				
68901	Macronychus glabratus	F	2 +				
69400	Stenelmis sp	F	20 +				
74100	Simulium sp	F	19 +				
77750	Hayesomyia senata or Thienemannimyia norena	F	220 +				

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/18/2022* RM: **107.50**

Site ID: **SR17** Location: *ust. Walnut Creek* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
00401	Spongillidae	F		+	82130	Thienemanniella similis	MI		+
01801	Turbellaria	F	164		82501	Chironomini			+
01900	Nemertea	F	16		82730	Chironomus (C.) decorus group	T		+
03000	Ectoprocta	F	1		83300	Glyptotendipes (G.) sp	MT	3847	+
03600	Oligochaeta	T		+	84400	Polypedilum sp			+
04666	Helobdella papillata	MT		+	84450	Polypedilum (Uresipedilum) flavum	F	99	+
04901	Erpobdellidae	MT		+	84540	Polypedilum (Tripodura) scalaenum group	F		+
05800	Caecidotea sp	T		+	85625	Rheotanytarsus sp	F	5425	+
11130	Baetis intercalaris	F	130	+	93200	Hydrobiidae	F		+
11155	Iswaeon anoka	MI		+	93900	Elimia sp	MI	2	+
12200	Isonychia sp	MI	259	+	97601	Corbicula fluminea	F		+
13400	Stenacron sp	F	92	+	97710	Dreissena polymorpha	F		+
13510	Maccaffertium exiguum	MI	603	+					
13570	Maccaffertium terminatum	MI	970	+					
16700	Tricorythodes sp	MI	134	+	No. Quantitative Taxa: 23		Total Taxa; 54		
17200	Caenis sp	F		+	No. Qualitative Taxa: 47		ICI: 42		
18100	Anthopotamus sp	MI		+	Number of Organisms: 15047		Qual EPT: 18		
22300	Argia sp	F		+					
24820	Gomphurus externus	MI		+					
26600	Didymops transversa	MT		+					
34605	Perlinella drymo	MI		+					
42700	Belostoma sp	T		+					
51206	Cyrnellus fraternus	F	1	+					
52200	Cheumatopsyche sp	F	1605	+					
52430	Ceratopsyche morosa group	MI	92						
52520	Hydropsyche bidens	MI	4	+					
52560	Hydropsyche orris	MI	540	+					
52570	Hydropsyche simulans	MI	449	+					
52801	Potamyia flava	MI	399	+					
53400	Protoptila sp	I		+					
59407	Nectopsyche candida	MI		+					
59580	Oecetis persimilis	MI	17						
59970	Petrophila sp	MI		+					
68130	Helichus sp	F		+					
68700	Dubiraphia sp	F		+					
68901	Macronychus glabratus	F		+					
69400	Stenelmis sp	F		+					
74100	Simulium sp	F		+					
77001	Tanypodinae		99						
77750	Hayesomyia senata or Thienemannimyia norena	F	99						
78655	Procladius (Holotanypus) sp	MT		+					
79100	Thienemannimyia group	F		+					

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/18/2022* RM: **105.25**

Site ID: **SR18** Location: *dst. Walnut Creek* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		18	74100	Simulium sp	F		307 +
03600	Oligochaeta	T		+	77120	Ablabesmyia mallochii	F		+
04666	Helobdella papillata	MT		+	77130	Ablabesmyia rhamphe group	MT		+
05800	Caecidotea sp	T		+	77750	Hayesomyia senata or Thienemannimyia norena	F		81 +
06700	Crangonyx sp	MT		+	78140	Labrundinia pilosella	F		+
08601	Hydrachnidia	F		16 +	80430	Cricotopus (C.) tremulus group	MT		20
11001	Baetidae			2	81825	Rheocricotopus (Psilocricotopus) robacki	F		20
11130	Baetis intercalaris	F		739 +	82730	Chironomus (C.) decorus group	T		+
11620	Paracloeodes minutus	MI		+	83040	Dicrotendipes neomodestus	F		+
11670	Proclleon viridoculare	MI		+	83300	Glyptotendipes (G.) sp	MT		41 +
12200	Isonychia sp	MI		312 +	83820	Microtendipes "caelum" (sensu Simpson & Bode, 1980)	MI		+
13000	Leucrocota sp	MI		+	84155	Paralauterborniella nigrohalteralis	F		+
13100	Nixe sp	MI		+	84450	Polypedilum (Uresipedilum) flavum	F		366
13510	Maccaffertium exiguum	MI		191	84612	Saetheria tylus	F		+
13561	Maccaffertium pulchellum	MI		+	85625	Rheotanytarsus sp	F		1483 +
13570	Maccaffertium terminatum	MI		184 +	85821	Tanytarsus glabrescens group sp 7	F		+
16700	Tricorythodes sp	MI		50 +	85840	Tanytarsus sepp	F		20
17200	Caenis sp	F		+	87540	Hemerodromia sp	F		34
18100	Anthopotamus sp	MI		8 +	93900	Elimia sp	MI		+
21300	Hetaerina sp	F		+	97601	Corbicula fluminea	F		+
22001	Coenagrionidae	T		+	97710	Dreissena polymorpha	F		+
22300	Argia sp	F		+					
23909	Boyeria vinosa	F		+					
24900	Gomphus sp	F		+					
34605	Perlinella drymo	MI		+					
34700	Agnetina capitata complex	MI		+	No. Quantitative Taxa:	32	Total Taxa;	64	
44501	Corixidae	F		+	No. Qualitative Taxa:	50	ICI:	56	
48410	Corydalus cornutus	MI		18	Number of Organisms:	8014	Qual EPT:	21	
50315	Chimarra obscura	MI		175 +					
52200	Cheumatopsyche sp	F		2597 +					
52430	Ceratopsyche morosa group	MI		326					
52520	Hydropsyche bidens	MI		26					
52560	Hydropsyche orris	MI		115 +					
52570	Hydropsyche simulans	MI		334 +					
52801	Potamyia flava	MI		431 +					
53201	Glossosomatidae	MI		16 +					
54160	Ochrotrichia sp	MI		27 +					
59407	Nectopsyche candida	MI		+					
59970	Petrophila sp	MI		16					
60900	Peltodytes sp	MT		+					
68601	Ancyronyx variegata	F		10					
68901	Macronychus glabratus	F		7					
69400	Stenelmis sp	F		24 +					

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/24/2022* RM: **102.00**

Site ID: **SR19** Location: *dst. Commerical Point Rd.* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		34 +	77500	Conchapelopia sp	F		141 +
03600	Oligochaeta	T		16 +	77750	Hayesomyia senata or	F		94 +
04666	Helobdella papillata	MT		+		Thienemannimyia norena			
04930	Erpobdella sp	MT		+	78655	Procladius (Holotanypus) sp	MT		+
05800	Caecidotea sp	T		+	80410	Cricotopus (C.) sp	F		47
08200	Orconectes sp	F		+	81240	Nanocladius (N.) distinctus	MT		47
11130	Baetis intercalaris	F		689 +	81825	Rheocricotopus (Psilocricotopus)	F		+
11670	Proclleon viridoculare	MI		+		robacki			
12200	Isonychia sp	MI		467 +	82100	Thienemanniella sp			+
13000	Leucrocota sp	MI		+	82600	Axarus sp	F		+
13400	Stenacron sp	F		+	82730	Chironomus (C.) decorus group	T		+
13510	Maccaffertium exiguum	MI		15	82822	Cryptochironomus eminentia	F		+
13561	Maccaffertium pulchellum	MI		+	83040	Dicrotendipes neomodestus	F		+
13570	Maccaffertium terminatum	MI		1126 +	83300	Glyptotendipes (G.) sp	MT		188 +
16700	Tricorythodes sp	MI		+	84450	Polypedilum (Uresipedilum) flavum	F		612 +
17200	Caenis sp	F		+	84470	Polypedilum (P.) illinoense	T		+
18100	Anthopotamus sp	MI		+	84520	Polypedilum (Tripodura) halterale	MT		+
22300	Argia sp	F		+		group			
23909	Boyeria vinosa	F		+	84540	Polypedilum (Tripodura)	F		+
25600	Stylurus sp	MI		+		scalaenum group			
26700	Macromia sp	MI		+	84612	Saetheria tylus	F		+
34600	Perlinella sp	MI		+	85625	Rheotanytarsus sp	F		3623 +
45400	Trichocorixa sp	MT		+	87540	Hemerodromia sp	F		48 +
50315	Chimarra obscura	MI		3 +	93900	Elimia sp	MI		+
52200	Cheumatopsyche sp	F		1821 +	95100	Physella sp	T		+
52430	Ceratopsyche morosa group	MI		146 +	96900	Ferrissia sp	F		+
52520	Hydropsyche bidens	MI		148	97601	Corbicula fluminea	F		+
52560	Hydropsyche orris	MI		365	99240	Lasmigona complanata	MI		+
52570	Hydropsyche simulans	MI		1164 +	99680	Leptodea fragilis	MI		+
52801	Potamyia flava	MI		874 +					
53800	Hydroptila sp	F		+	No. Quantitative Taxa:	25	Total Taxa;	68	
59407	Nectopsyche candida	MI		+	No. Qualitative Taxa:	61	ICI:	50	
59970	Petrophila sp	MI		+	Number of Organisms:	11912	Qual EPT:	18	
65800	Berosus sp	MT		+					
68130	Helichus sp	F		+					
68601	Ancyronyx variegata	F		+					
68700	Dubiraphia sp	F		+					
68901	Macronychus glabratus	F		32					
69400	Stenelmis sp	F		2 +					
72900	Culex sp	T		+					
74100	Simulium sp	F		114 +					
74501	Ceratopogonidae	T		96					
77120	Ablabesmyia mallochii	F		+					

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/24/2022* RM: **100.10**

Site ID: **SR20** Location: *Circleville Riffle_ust. US 22* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		1 +	80400	Cricotopus sp	F		+
03000	Ectoprocta	F		+	80410	Cricotopus (C.) sp	F		+
03600	Oligochaeta	T		32 +	81240	Nanocladius (N.) distinctus	MT		72
06700	Crangonyx sp	MT		+	82220	Tvetenia discoloripes group	MI		72
08601	Hydrachnidia	F		+	82730	Chironomus (C.) decorus group	T		+
11119	Plauditus dubius or P. virilis	I		+	82820	Cryptochironomus sp	F		+
11130	Baetis intercalaris	F		356 +	83040	Dicrotendipes neomodestus	F		36 +
11600	Paracloeodes fleeki	MI		+	83300	Glyptotendipes (G.) sp	MT		325 +
11620	Paracloeodes minutus	MI		+	84300	Phaenopsectra obediens group	F		+
12200	Isonychia sp	MI		323 +	84450	Polypedilum (Uresipedilum) flavum	F		362 +
13000	Leucrocuta sp	MI		2 +	84470	Polypedilum (P.) illinoense	T		+
13400	Stenacron sp	F		+	84960	Pseudochironomus sp	F		+
13510	Maccaffertium exiguum	MI		11	85625	Rheotanytarsus sp	F		2712 +
13540	Maccaffertium mediopunctatum	MI		2 +	86001	Tabanidae	F		+
13570	Maccaffertium terminatum	MI		1026 +	93900	Elimia sp	MI		+
16700	Tricorythodes sp	MI		+	96900	Ferrissia sp	F		+
18100	Anthopotamus sp	MI		+	97601	Corbicula fluminea	F		+
22001	Coenagrionidae	T		+	99400	Quadrula quadrula	MI		+
34715	Agnentina flavescens	I		1	99680	Leptodea fragilis	MI		+
45900	Notonecta sp	T		+	99700	Potamilus alatus	MI		+
50315	Chimarra obscura	MI		6					
52200	Cheumatopsyche sp	F		1735 +	No. Quantitative Taxa: 28		Total Taxa; 62		
52430	Ceratopsyche morosa group	MI		115 +	No. Qualitative Taxa: 54		ICI: 54		
52520	Hydropsyche bidens	MI		117	Number of Organisms: 9637		Qual EPT: 18		
52560	Hydropsyche orris	MI		457					
52570	Hydropsyche simulans	MI		761 +					
52801	Potamyia flava	MI		681 +					
53400	Protoptila sp	I		+					
53800	Hydroptila sp	F		17 +					
59407	Nectopsyche candida	MI		+					
59970	Petrophila sp	MI		+					
63900	Laccophilus sp	T		+					
68130	Helichus sp	F		+					
68601	Ancyronyx variegata	F		+					
68901	Macronychus glabratus	F		1 +					
69400	Stenelmis sp	F		41 +					
74100	Simulium sp	F		193 +					
77120	Ablabesmyia mallochi	F		+					
77500	Conchapelopia sp	F		72					
77750	Hayesomyia senata or Thienemannimyia norena	F		108 +					
78655	Procladius (Holotanypus) sp	MT		+					
80310	Cardiocladius obscurus	MI		+					

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/30/2022* RM: **99.40**

Site ID: **SR21** Location: *ust. Circleville WWTP* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		+	77750	Hayesomyia senata or Thienemannimyia norena	F	259	+
03600	Oligochaeta	T		+	78100	Labrundinia sp	F		+
04960	Erpobdella sp (= Mooreobdella)	MT		+	80410	Cricotopus (C.) sp	F		+
11015	Acerpenna sp	MI		1	80420	Cricotopus (C.) bicinctus	T		+
11119	Plauditus dubius or P. virilis	I		+	80440	Cricotopus (C.) trifascia	F		+
11130	Baetis intercalaris	F	702	+	80700	Eukiefferiella sp			+
11620	Paracloeodes minutus	MI		+	82100	Thienemanniella sp			+
11670	Proclleon viridoculare	MI		+	82220	Tvetenia discoloripes group	MI	37	
12200	Isonychia sp	MI	892	+	82730	Chironomus (C.) decorus group	T		+
13000	Leucrocota sp	MI		+	83040	Dicretendipes neomodestus	F		+
13400	Stenacron sp	F		+	83300	Glyptotendipes (G.) sp	MT	370	+
13521	Stenonema femoratum	F		+	84155	Paralauterborniella nigrohalteralis	F		+
13540	Maccaffertium mediopunctatum	MI	2	+	84300	Phaenopsectra obediens group	F	555	+
13570	Maccaffertium terminatum	MI	1139	+	84450	Polypedilum (Uresipedilum) flavum	F		+
16700	Tricorythodes sp	MI		+	84540	Polypedilum (Tripodura) scalaenum group	F		+
17200	Caenis sp	F		+	85625	Rheotanytarsus sp	F	1738	+
18100	Anthopotamus sp	MI		+	85800	Tanytarsus sp	F		+
22300	Argia sp	F		+	87540	Hemerodromia sp	F	16	
24800	Gomphurus sp	MI		+	93900	Elimia sp	MI		+
34715	Agnetina flavescens	I		+	96900	Ferrissia sp	F		+
43300	Ranatra sp	F		+	97601	Corbicula fluminea	F	1	+
45400	Trichocorixa sp	MT		+	97710	Dreissena polymorpha	F		+
50315	Chimarra obscura	MI	42	+					
51300	Neureclipsis sp	MI		+					
52200	Cheumatopsyche sp	F	1031	+					
52430	Ceratopsyche morosa group	MI	184	+					
52520	Hydropsyche bidens	MI	185	+					
52560	Hydropsyche orris	MI	513	+					
52570	Hydropsyche simulans	MI	920	+					
52580	Hydropsyche valanis	MI	1	+					
52801	Potamyia flava	MI	735	+					
53400	Protoptila sp	I		+					
53800	Hydroptila sp	F		+					
59407	Nectopsyche candida	MI		+					
59970	Petrophila sp	MI		+					
60900	Peltodytes sp	MT		+					
68901	Macronychus glabratus	F	1						
69400	Stenelmis sp	F	1	+					
72900	Culex sp	T		+					
74100	Simulium sp	F	313	+					
74501	Ceratopogonidae	T	16						
77120	Ablabesmyia mallochi	F		+					
77500	Conchapelopia sp	F	74						

No. Quantitative Taxa: 25 Total Taxa; 65
 No. Qualitative Taxa: 59 ICI: 52
 Number of Organisms: 9728 Qual EPT: 26

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/30/2022* RM: **99.00**

Site ID: **SR22** Location: Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01900	Nemertea	F		81	82730	Chironomus (C.) decorus group	T		+
03600	Oligochaeta	T		64 +	82820	Cryptochironomus sp	F		+
04601	Glossiphoniidae	MT		+	83300	Glyptotendipes (G.) sp	MT		606 +
05800	Caecidotea sp	T		+	83400	Harnischia sp	F		+
06700	Crangonyx sp	MT		+	84155	Paralauterborniella nigrohalteralis	F		+
11130	Baetis intercalaris	F		379 +	84300	Phaenopsectra obediens group	F		20 +
11150	Labiobaetis propinquus	MI		+	84420	Polypedilum (P.) n.sp 1	MI		20
11600	Paracloeodes fleeki	MI		+	84450	Polypedilum (Uresipedilum) flavum	F		411 +
12200	Isonychia sp	MI		89 +	84540	Polypedilum (Tripodura) scalaenum group	F		20 +
13000	Leucrocota sp	MI		+	84612	Saetheria tylus	F		+
13100	Nixe sp	MI		+	84700	Stenochironomus sp	F		+
13400	Stenacron sp	F		+	85260	Cladotanytarsus vanderwulpi group			+
13510	Maccaffertium exiguum	MI		+	85625	Rheotanytarsus sp	F		801 +
13540	Maccaffertium mediopunctatum	MI		434	85821	Tanytarsus glabrescens group sp 7	F		+
13570	Maccaffertium terminatum	MI		333 +	85840	Tanytarsus sepp	F		20 +
13590	Maccaffertium vicarium	MI		+	87540	Hemerodromia sp	F		97
16700	Tricorythodes sp	MI		4 +	93900	Elimia sp	MI		+
17200	Caenis sp	F		1 +	97601	Corbicula fluminea	F		+
18100	Anthopotamus sp	MI		+	99400	Quadrula quadrula	MI		+
34600	Perlinella sp	MI		+	99680	Leptodea fragilis	MI		+
50315	Chimarra obscura	MI		18	99700	Potamilus alatus	MI		+
52200	Cheumatopsyche sp	F		1177 +	99720	Potamilus ohioensis	MI		+
52430	Ceratopsyche morosa group	MI		124 +	99880	Lampsilis cardium	MI		+
52520	Hydropsyche bidens	MI		40					
52560	Hydropsyche orris	MI		985					
52570	Hydropsyche simulans	MI		444 +	No. Quantitative Taxa:	30	Total Taxa;		65
52801	Potamyia flava	MI		1568 +	No. Qualitative Taxa:	55	ICI:		46
53400	Protoptila sp	I		+	Number of Organisms:	8418	Qual EPT:		20
59407	Nectopsyche candida	MI		+					
68130	Helichus sp	F		+					
68601	Ancyronyx variegata	F		1					
68901	Macronychus glabratus	F		3					
69400	Stenelmis sp	F		1 +					
74100	Simulium sp	F		324 +					
77120	Ablabesmyia mallochii	F		+					
77750	Hayesomyia senata or Thienemannimyia norena	F		313 +					
78450	Nilotanypus fimbriatus	F		20					
78655	Procladius (Holotanypus) sp	MT		+					
80310	Cardiocladius obscurus	MI		+					
80410	Cricotopus (C.) sp	F		+					
80430	Cricotopus (C.) tremulus group	MT		+					
82100	Thienemanniella sp			20 +					

Appendix Table C-4. Macroinvertebrate taxa list for Scioto River mainstem sites in 2022

River Code: **02-001** River: **Scioto River** Coll. Date: *09/30/2022* RM: **97.90**

Site ID: **SR23** Location: *dst. Wicket Dam at Canal Park* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		164	77130	Ablabesmyia rhamphe group	MT		+
03000	Ectoprocta	F		4 +	77500	Conchapelopia sp	F		9
03600	Oligochaeta	T		16 +	77750	Hayesomyia senata or Thienemannimyia norena	F		121 +
05800	Caecidotea sp	T		+	78100	Labrundinia sp	F		+
06700	Crangonyx sp	MT		+	78450	Nilotanypus fimbriatus	F		16
08200	Orconectes sp	F		+	78599	Pentaneura sp	F		+
11130	Baetis intercalaris	F		452 +	80410	Cricotopus (C.) sp	F		9 +
11150	Labiobaetis propinquus	MI		+	80430	Cricotopus (C.) tremulus group	MT		+
11670	Proclleon viridoculare	MI		+	81240	Nanocladius (N.) distinctus	MT		+
12200	Isonychia sp	MI		804 +	82100	Thienemanniella sp			+
13000	Leucrocuta sp	MI		+	82220	Tvetenia discoloripes group	MI		43
13400	Stenacron sp	F		+	82820	Cryptochironomus sp	F		+
13510	Maccaffertium exiguum	MI		12 +	82880	Cryptotendipes sp	F		+
13521	Stenonema femoratum	F		+	83040	Dicrotendipes neomodestus	F		+
13540	Maccaffertium mediopunctatum	MI		+	83300	Glyptotendipes (G.) sp	MT		95 +
13561	Maccaffertium pulchellum	MI		+	83400	Harnischia sp	F		+
13570	Maccaffertium terminatum	MI		1591 +	84020	Parachironomus carinatus	F		+
16700	Tricorythodes sp	MI		+	84155	Paralauterborniella nigrohalteralis	F		+
17200	Caenis sp	F		32 +	84300	Phaenopsectra obediens group	F		+
18100	Anthopotamus sp	MI		+	84450	Polypedilum (Uresipedilum) flavum	F		121 +
22001	Coenagrionidae	T		+	84460	Polypedilum (P.) fallax group	F		9
22300	Argia sp	F		4 +	84470	Polypedilum (P.) illinoense	T		+
23909	Boyeria vinosa	F		+	85625	Rheotanytarsus sp	F		431 +
43300	Ranatra sp	F		+	85800	Tanytarsus sp	F		+
44501	Corixidae	F		+	85840	Tanytarsus sepp	F		+
45400	Trichocorixa sp	MT		+	87540	Hemerodromia sp	F		+
52200	Cheumatopsyche sp	F		1412 +	93900	Elimia sp	MI		+
52430	Ceratopsyche morosa group	MI		37 +	95100	Physella sp	T		+
52520	Hydropsyche bidens	MI		179 +	96900	Ferrissia sp	F		+
52560	Hydropsyche orris	MI		884 +	97601	Corbicula fluminea	F		+
52570	Hydropsyche simulans	MI		952 +	98600	Sphaerium sp	F		+
52801	Potamyia flava	MI		494 +					
53400	Protoptila sp	I		+					
53800	Hydroptila sp	F		4 +	No. Quantitative Taxa: 27		Total Taxa; 74		
59407	Nectopsyche candida	MI		+	No. Qualitative Taxa: 69		ICI: 50		
59970	Petrophila sp	MI		+	Number of Organisms: 7951		Qual EPT: 23		
60900	Peltodytes sp	MT		+					
68075	Psephenus herricki	MI		+					
68130	Helichus sp	F		+					
68601	Ancyronyx variegata	F		+					
69400	Stenelmis sp	F		20 +					
74100	Simulium sp	F		36 +					
77120	Ablabesmyia mallochii	F		+					

APPENDIX C: OLENTANGY RIVER MAINSTEM MACROINVERTEBRATE ASSEMBLAGE 2022

C-5: Olentangy River ICI Metrics and ICI Scores 2022

C-6: Olentangy River Macroinvertebrate Taxa Grand (all sites combined) 2022

C-7: Olentangy River Macroinvertebrate Taxa by Site 2022

Appendix Table C-5. ICI metrics and narrative for sites in Olentangy River mainstem study area sampled by MBI in 2022.

Site ID	River Mile	Drainage Area (sq mi)	Number of				Percent:					Qual. EPT	ICI or Narrative	
			Total Taxa ^a	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Mayflies	Caddisflies	Tany-tarsini	Other Dipt/NI	Tolerant Organisms			
Olentangy River (02-400)														
Year:2022														
OLN05	14.90	482.00	66										28	E
OLN07	13.30	489.00	38(6)	8(4)	6(6)	12(4)	10.0(2)	55.3(6)	0.2(2)	31.4(4)	0.5(6)	20(6)		46
OLN08	11.90	490.00	32(4)	8(4)	3(4)	9(2)	15.5(4)	32.9(6)	0.7(2)	48.1(0)	0.5(6)	25(6)		38
OLN09	8.50	510.00	25(4)	4(2)	5(4)	9(2)	6.5(2)	40.2(6)	1.2(2)	50.7(0)	0.3(6)	21(6)		34
OLN10	7.00	516.00	33(4)	11(6)	4(4)	9(2)	13.7(2)	35.9(6)	2.5(2)	46.2(0)	0.4(6)	21(6)		38
OLN11	5.50	524.00	31(4)	2(0)	2(2)	17(6)	19.9(4)	1.4(2)	2.0(2)	69.9(0)	13.2(0)	3(0)		20
OLN12	4.50	529.00	15(2)	2(0)	1(2)	6(2)	0.3(2)	18.2(4)	1.0(2)	79.2(0)	2.3(6)	4(0)		20
OLN01	3.90	531.00	43										15	VG
OLN02	2.00	537.00	24(4)	7(4)	4(4)	10(4)	20.1(4)	34.5(6)	3.3(2)	42.0(2)	0.7(6)	18(6)		42
OLN03	1.70	537.00	31(4)	8(4)	4(4)	9(2)	20.7(4)	35.3(6)	5.4(2)	38.3(2)	0.7(6)	16(4)		38
OLN04	0.20	543.00	41(6)	7(4)	5(4)	13(4)	28.5(6)	24.2(4)	6.5(2)	40.6(2)	0.4(6)	15(4)		42

^a For HD samples represents total QUANT taxa, but for QUAL samples represents QUAL taxa.

Appendix C-6 . continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
52200	<i>Cheumatopsyche sp</i>	F	C	10491	28.16	9	9
84450	<i>Polypedilum (Uresipedilum) flavum</i>	F	D	8229	22.09	9	9
01801	<i>Turbellaria</i>	F	N	4744	12.73	9	11
52430	<i>Ceratopsyche morosa group</i>	MI	C	1810	4.86	9	9
11130	<i>Baetis intercalaris</i>	F	M	1767	4.74	9	9
85625	<i>Rheotanytarsus sp</i>	F	T	1236	3.32	8	8
16700	<i>Tricorythodes sp</i>	MI	M	1102	2.96	9	9
13570	<i>Maccaffertium terminatum</i>	MI	M	1078	2.89	10	10
11120	<i>Baetis flavistriga</i>	F	M	959	2.57	7	7
13561	<i>Maccaffertium pulchellum</i>	MI	M	640	1.72	6	8
13400	<i>Stenacron sp</i>	F	M	421	1.13	10	11
84790	<i>Tribelos fuscicorne</i>	F	D	412	1.11	1	2
83300	<i>Glyptotendipes (G.) sp</i>	MT	D	380	1.02	3	6
83050	<i>Dicrotendipes lucifer</i>	MT	D	369	0.99	1	3
84700	<i>Stenochironomus sp</i>	F	D	303	0.81	0	5
51206	<i>Cyrnellus fraternus</i>	F	C	261	0.7	0	5
50315	<i>Chimarra obscura</i>	MI	C	191	0.51	6	6
13510	<i>Maccaffertium exiguum</i>	MI	M	182	0.49	4	5
77500	<i>Conchapelopia sp</i>	F	D	164	0.44	3	6
82220	<i>Tvetenia discoloripes group</i>	MI	D	155	0.42	3	4
93900	<i>Elimia sp</i>	MI	N	151	0.41	10	11
69400	<i>Stenelmis sp</i>	F	O	140	0.38	11	11
34715	<i>Agnatina flavescens</i>	I	S	129	0.35	5	6
03600	<i>Oligochaeta</i>	T	N	128	0.34	9	10
87540	<i>Hemerodromia sp</i>	F	D	113	0.3	1	5
53800	<i>Hydroptila sp</i>	F	C	105	0.28	3	4
78450	<i>Nilotanypus fimbriatus</i>	F	D	104	0.28	0	6
12200	<i>Isonychia sp</i>	MI	M	95	0.25	6	8

Appendix C-6. continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	F	D	82	0.22	10	11
77800	<i>Helopelopia sp</i>	F	D	78	0.21	9	9
96900	<i>Ferrissia sp</i>	F	N	76	0.2	6	8
84490	<i>Polypedilum (Cerobregma) ontario</i>	MI	D	74	0.2	2	3
01320	<i>Hydra sp</i>	F	N	70	0.19	0	6
22300	<i>Argia sp</i>	F	O	69	0.19	11	11
81231	<i>Nanocladius (N.) crassicornus or N. (N.) "r</i>	F	D	66	0.18	0	2
74100	<i>Simulium sp</i>	F	D	59	0.16	7	9
52801	<i>Potamyia flava</i>	MI	C	49	0.13	0	1
81240	<i>Nanocladius (N.) distinctus</i>	MT	D	48	0.13	2	3
79100	<i>Thienemannimyia group</i>	F	D	46	0.12	0	1
83040	<i>Dicrotendipes neomodestus</i>	F	D	41	0.11	3	4
08601	<i>Hydrachnidia</i>	F	N	33	0.09	6	7
80400	<i>Cricotopus sp</i>	F	D	31	0.08	0	1
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	F	D	31	0.08	0	1
84800	<i>Tribelos jucundum</i>	MT	D	31	0.08	0	1
68901	<i>Macronychus glabratus</i>	F	O	28	0.08	2	6
97601	<i>Corbicula fluminea</i>	F	N	25	0.07	8	8
96930	<i>Laevapex fuscus</i>	MT	N	24	0.06	3	4
83000	<i>Dicrotendipes sp</i>	F	D	24	0.06	1	2
01900	<i>Nemertea</i>	F	N	24	0.06	0	1
82501	<i>Chironomini</i>		D	24	0.06	0	1
05900	<i>Lirceus sp</i>	MT	N	22	0.06	9	9
77750	<i>Hayesomyia senata or Thienemannimyia</i>	F	D	22	0.06	2	2
81650	<i>Parametrioctenus sp</i>	F	D	21	0.06	0	1
52530	<i>Hydropsyche depravata group</i>	F	C	18	0.05	1	3
13000	<i>Leucocuta sp</i>	MI	M	17	0.05	9	9
59415	<i>Nectopsyche exquisita</i>	MI	C	17	0.05	9	9
85800	<i>Tanytarsus sp</i>	F	T	17	0.05	5	5

Appendix C-6. continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
16324	<i>Teloganopsis deficiens</i>	I	M	16	0.04	1	2
80363	<i>Corynoneura sp 12</i>	MI	D	16	0.04	0	1
84520	<i>Polypedilum (Tripodura) halterale group</i>	MT	D	15	0.04	1	2
82100	<i>Thienemanniella sp</i>		D	12	0.03	1	2
84210	<i>Paratendipes albimanus or P. duplicatus</i>	F	D	10	0.03	2	3
03360	<i>Plumatella sp</i>	F	N	9	0.02	0	1
53501	<i>Hydroptilidae</i>	F	C	9	0.02	0	1
78655	<i>Procladius (Holotanypus) sp</i>	MT	D	8	0.02	7	7
98600	<i>Sphaerium sp</i>	F	N	8	0.02	5	6
04510	<i>Hirudinida</i>	MT	N	8	0.02	1	3
87501	<i>Empididae</i>	F	D	8	0.02	0	1
98001	<i>Pisidiidae</i>		N	8	0.02	0	2
84300	<i>Phaenopsectra obediens group</i>	F	D	7	0.02	3	3
11020	<i>Acerpenna pygmaea</i>	MI	M	7	0.02	2	3
11010	<i>Acentrella sp</i>	I	M	7	0.02	1	1
82710	<i>Chironomus (C.) sp</i>	MT	D	6	0.02	1	1
78600	<i>Pentaneura inconspicua</i>	F	D	6	0.02	0	1
05800	<i>Caecidotea sp</i>	T	N	5	0.01	6	6
13521	<i>Stenonema femoratum</i>	F	M	5	0.01	3	4
82822	<i>Cryptochironomus eminentia</i>	F	D	5	0.01	2	2
84460	<i>Polypedilum (P.) fallax group</i>	F	D	5	0.01	2	3
85001	<i>Tanytarsini</i>		T	5	0.01	0	1
59500	<i>Oecetis sp</i>	F	C	4	0.01	1	2
03451	<i>Urnatella gracilis</i>	MI	N	4	0.01	0	1
15501	<i>Ephemerellidae</i>	MI	M	4	0.01	0	1
77120	<i>Ablabesmyia mallochi</i>	F	D	3	0.01	8	9
85840	<i>Tanytarsus sepp</i>	F	T	3	0.01	3	4
13550	<i>Maccaffertium mexicanum integrum</i>	MI	M	3	0.01	0	1
22001	<i>Coenagrionidae</i>	T	O	2	0.01	10	10

Appendix C-6. continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
59970	<i>Petrophila sp</i>	MI	O	2	0.01	9	9
03000	<i>Ectoprocta</i>	F		2	0.01	1	2
78140	<i>Labrundinia pilosella</i>	F	D	2	0.01	1	2
82880	<i>Cryptotendipes sp</i>	F	D	2	0.01	0	1
84155	<i>Paralauterborniella nigrohalteralis</i>	F	D	2	0.01	0	1
68075	<i>Psephenus herricki</i>	MI	O	1	0	9	9
68601	<i>Ancyronyx variegata</i>	F	O	1	0	7	7
59407	<i>Nectopsyche candida</i>	MI	C	1	0	5	5
52580	<i>Hydropsyche valanis</i>	MI	C	1	0	4	4
18619	<i>Ephemera simulans</i>	MI	M	1	0	3	3
21300	<i>Hetaerina sp</i>	F	O	1	0	3	4
21001	<i>Calopterygidae</i>	F	O	1	0	2	3
71900	<i>Tipula sp</i>	F	D	1	0	2	3
04930	<i>Erpobdella sp</i>	MT	N	1	0	1	2
51001	<i>Polycentropodidae</i>		C	1	0	0	1
68501	<i>Elmidae</i>		O	1	0	0	1
80350	<i>Corynoneura sp</i>		D	1	0	0	1
95501	<i>Planorbidae</i>	MT	N	1	0	0	1
06201	<i>Hyalella azteca</i>	F	N	0	0	10	10
53400	<i>Protoptila sp</i>	I	C	0	0	9	9
84470	<i>Polypedilum (P.) illinoense</i>	T	D	0	0	8	8
06700	<i>Crangonyx sp</i>	MT	N	0	0	7	7
58505	<i>Helicopsyche borealis</i>	MI	C	0	0	7	7
95100	<i>Physella sp</i>	T	N	0	0	7	7
13100	<i>Nixe sp</i>	MI	M	0	0	6	6
18600	<i>Ephemera sp</i>	MI	M	0	0	6	6
82820	<i>Cryptochironomus sp</i>	F	D	0	0	5	5
08200	<i>Orconectes sp</i>	F	N	0	0	4	4
18100	<i>Anthopotamus sp</i>	MI	M	0	0	4	4

Appendix C-6. continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
26700	<i>Macromia sp</i>	MI	O	0	0	4	4
59700	<i>Triaenodes sp</i>	MI	C	0	0	4	4
11119	<i>Plauditus dubius or P. virilis</i>	I	M	0	0	3	3
21200	<i>Calopteryx sp</i>	F	O	0	0	3	3
27400	<i>Neurocordulia sp</i>	F	O	0	0	3	3
68708	<i>Dubiraphia vittata group</i>	F	O	0	0	3	3
72900	<i>Culex sp</i>	T	D	0	0	3	3
82730	<i>Chironomus (C.) decorus group</i>	T	D	0	0	3	3
97710	<i>Dreissena polymorpha</i>	F	N	0	0	3	3
04666	<i>Helobdella papillata</i>	MT	N	0	0	2	2
04901	<i>Erpobdellidae</i>	MT	N	0	0	2	2
04935	<i>Erpobdella punctata punctata</i>	MT	N	0	0	2	2
08250	<i>Orconectes (Procericambarus) rusticus</i>	F	N	0	0	2	2
11670	<i>Proclleon viridoculare</i>	MI	M	0	0	2	2
23600	<i>Aeshna sp</i>	MT	O	0	0	2	2
59715				0	0	2	2
59740	<i>Triaenodes perna</i>	MI	C	0	0	2	2
60900	<i>Peltodytes sp</i>	MT	O	0	0	2	2
68700	<i>Dubiraphia sp</i>	F	O	0	0	2	2
81060	<i>Lopescladius sp</i>	MI	D	0	0	2	2
85265	<i>Cladotanytarsus vanderwulpi group sp 5</i>	MI	T	0	0	2	2
85500	<i>Paratanytarsus sp</i>	F	T	0	0	2	2
85821	<i>Tanytarsus glabrescens group sp 7</i>	F	T	0	0	2	2
93200	<i>Hydrobiidae</i>	F	N	0	0	2	2
04964	<i>Erpobdella microstoma</i>	MT	N	0	0	1	1
11200	<i>Callibaetis sp</i>	MT	M	0	0	1	1
11650	<i>Proclleon sp (w/ hindwing pads)</i>	MI	M	0	0	1	1
17200	<i>Caenis sp</i>	F	M	0	0	1	1
23905	<i>Boyeria grafiana</i>	MI	O	0	0	1	1

Appendix C-6. continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
23909	<i>Boyeria vinosa</i>	F	O	0	0	1	1
24107	<i>Nasiaeschna pentacantha</i>	MT	O	0	0	1	1
27001	<i>Corduliidae</i>		O	0	0	1	1
28001	<i>Libellulidae</i>	MT	O	0	0	1	1
34700	<i>Agnetina capitata complex</i>	MI	S	0	0	1	1
43300	<i>Ranatra sp</i>	F	O	0	0	1	1
45400	<i>Trichocorixa sp</i>	MT	O	0	0	1	1
48410	<i>Corydalus cornutus</i>	MI	O	0	0	1	1
52520	<i>Hydropsyche bidens</i>	MI	C	0	0	1	1
52590	<i>Hydropsyche venularis</i>	MI	C	0	0	1	1
57400	<i>Neophylax sp</i>	MI	C	0	0	1	1
59001	<i>Leptoceridae</i>		C	0	0	1	1
59110	<i>Ceraclea ancylus</i>	MI	C	0	0	1	1
59410	<i>Nectopsyche diarina</i>	MI	C	0	0	1	1
59720	<i>Trienodes ignitus</i>	MI	C	0	0	1	1
59724	<i>Trienodes injustus</i>	MI	C	0	0	1	1
65800	<i>Berosus sp</i>	MT	O	0	0	1	1
66500	<i>Enochrus sp</i>	MT	O	0	0	1	1
67800	<i>Tropisternus sp</i>	T	O	0	0	1	1
72700	<i>Anopheles sp</i>	F	D	0	0	1	1
74501	<i>Ceratopogonidae</i>	T	D	0	0	1	1
77130	<i>Ablabesmyia rhamphe group</i>	MT	D	0	0	1	1
78100	<i>Labrundinia sp</i>	F	D	0	0	1	1
82885	<i>Cryptotendipes pseudotener</i>	F	D	0	0	1	1
83158	<i>Endochironomus nigricans</i>	MT	D	0	0	1	1
83400	<i>Harnischia sp</i>	F	D	0	0	1	1
84000	<i>Parachironomus sp</i>	MT	D	0	0	1	1
84020	<i>Parachironomus carinatus</i>	F	D	0	0	1	1
85200	<i>Cladotanytarsus sp</i>		T	0	0	1	1

Appendix C-6. continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	HD Abundance	HD Percent	Qual. Samples	Collection Frequency
85700	<i>Stempellina sp</i>	MI	T	0	0	1	1
85818	<i>Tanytarsus glabrescens group sp 4</i>	F	T	0	0	1	1
92600	<i>Cipangopaludina sp</i>	MT	N	0	0	1	1
92615	<i>Cipangopaludina japonica</i>	MT	N	0	0	1	1
98200	<i>Pisidium sp</i>	MT	N	0	0	1	1

Appendix Table C-7. Macroinvertebrate taxa list for Olentangy River mainstem sites in 2022

River Code: **02-400** River: *Olentangy River* Coll. Date: *09/09/2022* RM: **14.90**

Site ID: **OLN05** Location: *dst. OH-750* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		+	68708	Dubiraphia vittata group	F		+
03600	Oligochaeta	T		+	69400	Stenelmis sp	F		+
05900	Lirceus sp	MT		+	71900	Tipula sp	F		+
06201	Hyalella azteca	F		+	74100	Simulium sp	F		+
08601	Hydrachnidia	F		+	77120	Ablabesmyia mallochi	F		+
11020	Acerpenna pygmaea	MI		+	77800	Helopelopia sp	F		+
11120	Baetis flavistriga	F		+	78140	Labrundinia pilosella	F		+
11130	Baetis intercalaris	F		+	78655	Procladius (Holotanypus) sp	MT		+
11200	Callibaetis sp	MT		+	82220	Tvetenia discoloripes group	MI		+
12200	Isonychia sp	MI		+	82730	Chironomus (C.) decorus group	T		+
13000	Leucrocuta sp	MI		+	82885	Cryptotendipes pseudotener	F		+
13100	Nixe sp	MI		+	84450	Polypedilum (Uresipedilum) flavum	F		+
13400	Stenacron sp	F		+	84460	Polypedilum (P.) fallax group	F		+
13510	Maccaffertium exiguum	MI		+	84470	Polypedilum (P.) illinoense	T		+
13521	Stenonema femoratum	F		+	84540	Polypedilum (Tripodura) scalaenum group	F		+
13561	Maccaffertium pulchellum	MI		+					
13570	Maccaffertium terminatum	MI		+	85500	Paratanytarsus sp	F		+
16324	Teloganopsis deficiens	I		+	85625	Rheotanytarsus sp	F		+
16700	Tricorythodes sp	MI		+	85700	Stempellina sp	MI		+
18100	Anthopotamus sp	MI		+	85818	Tanytarsus glabrescens group sp 4	F		+
18600	Ephemera sp	MI		+	93900	Elimia sp	MI		+
21300	Hetaerina sp	F		+	95100	Physella sp	T		+
22001	Coenagrionidae	T		+	97601	Corbicula fluminea	F		+
22300	Argia sp	F		+	98600	Sphaerium sp	F		+
23909	Boyeria vinosa	F		+					
34700	Agnetina capitata complex	MI		+	No. Quantitative Taxa: 0		Total Taxa; 66		
50315	Chimarra obscura	MI		+	No. Qualitative Taxa: 66		ICI: E		
52200	Cheumatopsyche sp	F		+	Number of Organisms: 0		Qual EPT: 28		
52430	Ceratopsyche morosa group	MI		+					
52530	Hydropsyche depravata group	F		+					
52590	Hydropsyche venularis	MI		+					
53400	Protoptila sp	I		+					
53800	Hydroptila sp	F		+					
57400	Neophylax sp	MI		+					
58505	Helicopsyche borealis	MI		+					
59415	Nectopsyche exquisita	MI		+					
59724	Trienodes injustus	MI		+					
59740	Trienodes perna	MI		+					
59970	Petrophila sp	MI		+					
60900	Peltodytes sp	MT		+					
65800	Berosus sp	MT		+					
68075	Psephenus herricki	MI		+					
68601	Ancyronyx variegata	F		+					

Appendix Table C-7. Macroinvertebrate taxa list for Olentangy River mainstem sites in 2022

River Code: **02-400** River: **Olentangy River** Coll. Date: *09/09/2022* RM: **13.30**

Site ID: **OLN07** Location: *dst. Olentangy WRF* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		407 +	72900	Culex sp	T		+
03451	Urnatella gracilis	MI		4	74100	Simulium sp	F		+
03600	Oligochaeta	T		5 +	77120	Ablabesmyia mallochii	F		+
04510	Hirudinida	MT		+	77500	Conchapelopia sp	F		16
05900	Lirceus sp	MT		17 +	77750	Hayesomyia senata or Thienemannimyia norena	F		22 +
06201	Hyalella azteca	F		+	77800	Helopelopia sp	F		5 +
06700	Crangonyx sp	MT		+	78450	Nilotanypus fimbriatus	F		4
08200	Orconectes sp	F		+	78655	Procladius (Holotanypus) sp	MT		+
11020	Acerpenna pygmaea	MI		+	82820	Cryptochironomus sp	F		+
11120	Baetis flavistriga	F		+	82822	Cryptochironomus eminentia	F		5 +
11130	Baetis intercalaris	F		21 +	84210	Paratendipes albimanus or P. duplicatus	F		5 +
11670	Proclleon viridoculare	MI		+	84300	Phaenopsectra obediens group	F		5 +
12200	Isonychia sp	MI		2	84450	Polypedilum (Uresipedilum) flavum	F		382 +
13000	Leucrocota sp	MI		7 +	84460	Polypedilum (P.) fallax group	F		5
13100	Nixe sp	MI		+	84470	Polypedilum (P.) illinoense	T		+
13400	Stenacron sp	F		1 +	84490	Polypedilum (Cerobregma) ontario	MI		5 +
13510	Maccaffertium exiguum	MI		1	84540	Polypedilum (Tripodura) scalaenum group	F		49 +
13561	Maccaffertium pulchellum	MI		3	85001	Tanytarsini			5
13570	Maccaffertium terminatum	MI		297 +	85800	Tanytarsus sp	F		+
16700	Tricorythodes sp	MI		2 +	93200	Hydrobiidae	F		+
18600	Ephemera sp	MI		+	93900	Elimia sp	MI		99 +
21001	Calopterygidae	F		+	95100	Physella sp	T		+
22001	Coenagrionidae	T		+	96900	Ferrissia sp	F		8 +
22300	Argia sp	F		18 +	97601	Corbicula fluminea	F		3 +
26700	Macromia sp	MI		+	98001	Pisidiidae			4
27400	Neurocordulia sp	F		+					
34715	Agnetina flavescens	I		28 +					
50315	Chimarra obscura	MI		115 +					
52200	Cheumatopsyche sp	F		1519 +					
52430	Ceratopsyche morosa group	MI		206 +	No. Quantitative Taxa:	38	Total Taxa;	68	
52580	Hydropsyche valanis	MI		1 +	No. Qualitative Taxa:	58	ICI:	46	
53400	Protoptila sp	I		+	Number of Organisms:	3340	Qual EPT:	20	
58505	Helicopsyche borealis	MI		+					
59407	Nectopsyche candida	MI		1 +					
59415	Nectopsyche exquisita	MI		+					
59500	Oecetis sp	F		4					
59700	Trienodes sp	MI		+					
59970	Petrophila sp	MI		+					
68075	Psephenus herricki	MI		1 +					
68601	Ancyronyx variegata	F		+					
68708	Dubiraphia vittata group	F		+					
69400	Stenelmis sp	F		58 +					
71900	Tipula sp	F		+					

Appendix Table C-7. Macroinvertebrate taxa list for Olentangy River mainstem sites in 2022

River Code: **02-400** River: **Olentangy River** Coll. Date: *09/09/2022* RM: **11.90**

Site ID: **OLN08** Location: *ust. I-270* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01320	Hydra sp	F		12	68901	Macronychus glabratus	F		+
01801	Turbellaria	F		95	69400	Stenelmis sp	F		11 +
03600	Oligochaeta	T		4 +	72900	Culex sp	T		+
04510	Hirudinida	MT		4	74100	Simulium sp	F		9 +
04901	Erpobdellidae	MT		+	77120	Ablabesmyia mallochi	F		+
05900	Lirceus sp	MT		4 +	77500	Conchapelopia sp	F		45 +
06201	Hyalella azteca	F		+	77800	Helopelopia sp	F		11 +
08200	Orconectes sp	F		+	78450	Nilotanypus fimbriatus	F		24
08601	Hydrachnidia	F		+	78600	Pentaneura inconspicua	F		6
11119	Plauditus dubius or P. virilis	I		+	78655	Procladius (Holotanypus) sp	MT		+
11120	Baetis flavistriga	F		20 +	82730	Chironomus (C.) decorus group	T		+
11130	Baetis intercalaris	F		45 +	82820	Cryptochironomus sp	F		+
12200	Isonychia sp	MI		2 +	83050	Dicrotendipes lucifer	MT		+
13000	Leucrocota sp	MI		3 +	83300	Glyptotendipes (G.) sp	MT		+
13100	Nixe sp	MI		+	83400	Harnischia sp	F		+
13400	Stenacron sp	F		14 +	84210	Paratendipes albimanus or P. duplicatus	F		+
13521	Stenonema femoratum	F		+	84450	Polypedilum (Uresipedilum) flavum	F		459 +
13561	Maccaffertium pulchellum	MI		6 +	84470	Polypedilum (P.) illinoense	T		+
13570	Maccaffertium terminatum	MI		128 +	84540	Polypedilum (Tripodura) scalaenum group	F		28 +
16700	Tricorythodes sp	MI		26 +	84700	Stenochironomus sp	F		17
17200	Caenis sp	F		+	85625	Rheotanytarsus sp	F		11 +
18100	Anthopotamus sp	MI		+	85840	Tanytarsus sepp	F		+
18600	Ephemera sp	MI		+	93900	Elimia sp	MI		16 +
21300	Hetaerina sp	F		+	95100	Physella sp	T		+
22001	Coenagrionidae	T		+	96900	Ferrissia sp	F		4 +
22300	Argia sp	F		5 +	97601	Corbicula fluminea	F		14 +
26700	Macromia sp	MI		+	98001	Pisidiidae			4
34715	Agnatina flavescens	I		29 +					
43300	Ranatra sp	F		+					
50315	Chimarra obscura	MI		27 +					
52200	Cheumatopsyche sp	F		431 +	No. Quantitative Taxa:	32	Total Taxa;	70	
52430	Ceratopsyche morosa group	MI		59 +	No. Qualitative Taxa:	63	ICI:	38	
52580	Hydropsyche valanis	MI		+	Number of Organisms:	1573	Qual EPT:	25	
53400	Protoptila sp	I		+					
58505	Helicopsyche borealis	MI		+					
59410	Nectopsyche diarina	MI		+					
59415	Nectopsyche exquisita	MI		+					
59720	Trienodes ignitus	MI		+					
59740	Trienodes perna	MI		+					
59970	Petrophila sp	MI		+					
68075	Psephenus herricki	MI		+					
68601	Ancyronyx variegata	F		+					
68700	Dubiraphia sp	F		+					

Appendix Table C-7. Macroinvertebrate taxa list for Olentangy River mainstem sites in 2022

River Code: **02-400** River: **Olentangy River** Coll. Date: *09/15/2022* RM: **8.50**

Site ID: **OLN09** Location: *dst. Broad Meadows Dam* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01320	Hydra sp	F		16	77120	Ablabesmyia mallochi	F		+
01801	Turbellaria	F		1389 +	77500	Conchapelopia sp	F		62 +
03600	Oligochaeta	T		24 +	77800	Helopelopia sp	F		+
04510	Hirudinida	MT		4	78100	Labrundinia sp	F		+
04935	Erpobdella punctata punctata	MT		+	78450	Nilotanypus fimbriatus	F		16
05900	Lirceus sp	MT		+	81650	Parametricnemus sp	X F		21
06201	Hyalella azteca	F		+	82100	Thienemanniella sp			+
08200	Orconectes sp	F		+	83000	Dicrotendipes sp	F		+
11119	Plauditus dubius or P. virilis	I		+	83040	Dicrotendipes neomodestus	F		+
11120	Baetis flavistriga	F		+	83300	Glyptotendipes (G.) sp	MT		21 +
11130	Baetis intercalaris	F		123 +	84020	Parachironomus carinatus	F		+
11670	Procloeon viridoculare	MI		+	84450	Polypedilum (Uresipedilum) flavum	F		1925 +
12200	Isonychia sp	MI		11 +	84470	Polypedilum (P.) illinoense	T		+
13000	Leucrocota sp	MI		+	84540	Polypedilum (Tripodura) scalaenum group	F		+
13400	Stenacron sp	F		+	84700	Stenochironomus sp	F		21
13570	Maccaffertium terminatum	MI		300 +	85500	Paratanytarsus sp	F		+
16700	Tricorythodes sp	MI		+	85625	Rheotanytarsus sp	F		83 +
21001	Calopterygidae	F		+	87540	Hemerodromia sp	F		16
21300	Hetaerina sp	F		+	93900	Elimia sp	MI		+
22001	Coenagrionidae	T		+	95100	Physella sp	T		+
22300	Argia sp	F		+	96900	Ferrissia sp	F		+
23905	Boyeria grafiana	X MI		+	97710	Dreissena polymorpha	F		+
34715	Agnatina flavescens	I		42 +	98200	Pisidium sp	MT		+
50315	Chimarra obscura	MI		49 +	98600	Sphaerium sp	F		+
52200	Cheumatopsyche sp	F		2565 +					
52430	Ceratopsyche morosa group	MI		152 +					
52530	Hydropsyche depravata group	F		3	No. Quantitative Taxa: 24				Total Taxa; 67
52580	Hydropsyche valanis	MI		+	No. Qualitative Taxa: 58				ICI: 34
53400	Protophila sp	I		+	Number of Organisms: 6911				Qual EPT: 21
53800	Hydroptila sp	F		16 +					
58505	Helicopsyche borealis	MI		+					
59110	Ceraclea ancylus	MI		+					
59407	Nectopsyche candida	MI		+					
59415	Nectopsyche exquisita	MI		+					
59700	Trienodes sp	MI		+					
59970	Petrophila sp	MI		+					
67800	Tropisternus sp	T		+					
68075	Psephenus herricki	MI		+					
68901	Macronychus glabratus	F		16					
69400	Stenelmis sp	F		35 +					
71900	Tipula sp	F		1					
74100	Simulium sp	F		+					
74501	Ceratopogonidae	T		+					

Appendix Table C-7. Macroinvertebrate taxa list for Olentangy River mainstem sites in 2022

River Code: **02-400** River: **Olentangy River** Coll. Date: *09/15/2022* RM: **7.00**

Site ID: **OLN10** Location: *ust. Henderson Rd.* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01320	Hydra sp	F		8	68901	Macronychus glabratus	F		9
01801	Turbellaria	F		215 +	69400	Stenelmis sp	F		12 +
03600	Oligochaeta	T		+	74100	Simulium sp	F		14 +
04666	Helobdella papillata	MT		+	77120	Ablabesmyia mallochi	F		+
05800	Caecidotea sp	T		+	77800	Helopelopia sp	F		+
05900	Lirceus sp	MT		1 +	78450	Nilotanypus fimbriatus	F		20
06201	Hyalella azteca	F		+	81060	Lopescladius sp	MI		+
06700	Crangonyx sp	MT		+	81231	Nanocladius (N.) crassicornus or N. (N.) "rectinervis"	F		43
08601	Hydrachnidia	F		+	81240	Nanocladius (N.) distinctus	MT		+
11010	Acentrella sp	I		7 +	82100	Thienemanniella sp			12
11020	Acerpenna pygmaea	MI		7	82220	Tvetenia discoloripes group	MI		14 +
11120	Baetis flavistriga	F		7 +	82820	Cryptochironomus sp	F		+
11130	Baetis intercalaris	F		195 +	84000	Parachironomus sp	MT		+
12200	Isonychia sp	MI		13 +	84300	Phaenopsectra obediens group	F		+
13000	Leucrocuta sp	MI		7 +	84450	Polypedilum (Uresipedilum) flavum	F		939 +
13100	Nixe sp	MI		+	84540	Polypedilum (Tripodura) scalaenum group	F		+
13400	Stenacron sp	F		20 +	84700	Stenochironomus sp	F		28
13510	Maccaffertium exiguum	MI		+	85200	Cladotanytarsus sp			+
13561	Maccaffertium pulchellum	MI		100	85625	Rheotanytarsus sp	F		71 +
13570	Maccaffertium terminatum	MI		30 +	85800	Tanytarsus sp	F		+
15501	Ephemerellidae	MI		4	85821	Tanytarsus glabrescens group sp 7	F		+
16700	Tricorythodes sp	MI		1 +	85840	Tanytarsus sepp	F		+
18100	Anthopotamus sp	MI		+	87540	Hemerodromia sp	F		8
18619	Ephemera simulans	MI		+	93900	Elimia sp	MI		4 +
21200	Calopteryx sp	F		+	96900	Ferrissia sp	F		12 +
22300	Argia sp	F		1 +	97601	Corbicula fluminea	F		+
23600	Aeshna sp	MT		+	98600	Sphaerium sp	F		+
24107	Nasiaeschna pentacantha	MT		+					
34715	Agnetina flavescens	I		28 +					
52200	Cheumatopsyche sp	F		827 +					
52430	Ceratopsyche morosa group	MI		173 +	No. Quantitative Taxa:	33	Total Taxa;	70	
52530	Hydropsyche depravata group	F		15	No. Qualitative Taxa:	58	ICI:	38	
52580	Hydropsyche valanis	MI		+	Number of Organisms:	2854	Qual EPT:	21	
53400	Protoptila sp	I		+					
53501	Hydroptilidae	F		9					
58505	Helicopsyche borealis	MI		+					
59407	Nectopsyche candida	MI		+					
59415	Nectopsyche exquisita	MI		+					
59700	Trienodes sp	MI		+					
59970	Petrophila sp	MI		+					
68075	Psephenus herricki	MI		+					
68601	Ancyronyx variegata	F		+					
68700	Dubiraphia sp	F		+					

Appendix Table C-7. Macroinvertebrate taxa list for Olentangy River mainstem sites in 2022

River Code: **02-400** River: **Olentangy River** Coll. Date: *09/20/2022* RM: **5.50**

Site ID: **OLN11** Location: *ust. W. North Broadway, dst. Adena Brook* Sample:

Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.
01320	Hydra sp	F	13	85800	Tanytarsus sp	F	3 +
01801	Turbellaria	F	5 +	85840	Tanytarsus sepp	F	3
03600	Oligochaeta	T	31 +	93900	Elimia sp	MI	7 +
04935	Erpobdella punctata punctata	MT	+	95100	Physella sp	T	+
05800	Caecidotea sp	T	4 +	96900	Ferrissia sp	F	2
06201	Hyalella azteca	F	+	96930	Laevapex fuscus	MT	+
06700	Crangonyx sp	MT	+				
08601	Hydrachnidia	F	1 +	No. Quantitative Taxa: 31		Total Taxa; 46	
13400	Stenacron sp	F	54	No. Qualitative Taxa: 28		ICI: 20	
13521	Stenonema femoratum	F	5	Number of Organisms: 296		Qual EPT: 3	
21200	Calopteryx sp	F	+				
22001	Coenagrionidae	T	2 +				
22300	Argia sp	F	17 +				
27400	Neurocordulia sp	F	+				
51001	Polycentropodidae		1				
51206	Cynellus fraternus	F	3				
59001	Leptoceridae		+				
59407	Nectopsyche candida	MI	+				
59415	Nectopsyche exquisita	MI	+				
66500	Enochrus sp	MT	+				
68501	Elmidae		1				
68601	Ancyronyx variegata	F	+				
68708	Dubiraphia vittata group	F	+				
69400	Stenelmis sp	F	+				
72700	Anopheles sp	F	+				
77120	Ablabesmyia mallochi	F	3				
77500	Conchapelopia sp	F	3				
78140	Labrundinia pilosella	F	2				
78655	Procladius (Holotanypus) sp	MT	8 +				
80350	Corynoneura sp		1				
82710	Chironomus (C.) sp	MT	6 +				
82880	Cryptotendipes sp	F	2				
83050	Dicrotendipes lucifer	MT	14				
83300	Glyptotendipes (G.) sp	MT	5 +				
84155	Paralauterborniella nigrohalteralis	F	2				
84210	Paratendipes albimanus or P. duplicatus	F	5				
84300	Phaenopsectra obediens group	F	2 +				
84520	Polypedilum (Tripodura) halterale group	MT	15				
84540	Polypedilum (Tripodura) scalaenum group	F	5				
84790	Tribelos fuscicorne	F	71 +				

Appendix Table C-7. Macroinvertebrate taxa list for Olentangy River mainstem sites in 2022

River Code: **02-400** River: **Olentangy River** Coll. Date: *09/20/2022* RM: **4.50**

Site ID: **OLN12** Location: *ust. Dodridge Dam, adj. OSU wetlands* Sample:

Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.
01320	Hydra sp	F	13				
01801	Turbellaria	F	1	No. Quantitative Taxa:	15	Total Taxa;	37
03000	Ectoprocta	F	2	No. Qualitative Taxa:	27	ICI:	20
03600	Oligochaeta	T	32	Number of Organisms:	1386	Qual EPT:	4
04666	Helobdella papillata	MT	+				
05800	Caecidotea sp	T	+				
06201	Hyaella azteca	F	+				
06700	Crangonyx sp	MT	+				
08250	Orconectes (Procericambarus) rusticus	F	+				
08601	Hydrachnidia	F	+				
13400	Stenacron sp	F	3 +				
13570	Maccaffertium terminatum	MI	+				
18619	Ephemera simulans	MI	1 +				
22001	Coenagrionidae	T	+				
22300	Argia sp	F	16 +				
27400	Neurocordulia sp	F	+				
28001	Libellulidae	MT	+				
51206	Cyrnellus fraternus	F	252				
59700	Trienodes sp	MI	+				
68601	Ancyronyx variegata	F	+				
69400	Stenelmis sp	F	+				
77130	Ablabesmyia rhamphe group	MT	+				
77500	Conchapelopia sp	F	14 +				
78655	Procladius (Holotanypus) sp	MT	+				
83040	Dicrotendipes neomodestus	F	41				
83050	Dicrotendipes lucifer	MT	355				
83300	Glyptotendipes (G.) sp	MT	300				
84470	Polypedilum (P.) illinoense	T	+				
84540	Polypedilum (Tripodura) scalaenum group	F	+				
84790	Tribelos fuscicorne	F	341				
85800	Tanytarsus sp	F	14 +				
85840	Tanytarsus sepp	F	+				
92600	Cipangopaludina sp	MT	+				
93200	Hydrobiidae	F	+				
93900	Elimia sp	MI	+				
95100	Physella sp	T	+				
95501	Planorbidae	MT	1				

Appendix Table C-7. Macroinvertebrate taxa list for Olentangy River mainstem sites in 2022

River Code: **02-400** River: **Olentangy River** Coll. Date: *09/11/2022* RM: **3.90**

Site ID: **OLN01** Location: *dst. Dodridge dam* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		+	98600	Sphaerium sp	F		+
03600	Oligochaeta	T		+					
05800	Caecidotea sp	T		+	No. Quantitative Taxa: 0		Total Taxa; 43		
05900	Lirceus sp	MT		+	No. Qualitative Taxa: 43		ICI: VG		
06700	Crangonyx sp	MT		+	Number of Organisms: 0		Qual EPT: 15		
08200	Orconectes sp	F		+					
11130	Baetis intercalaris	F		+					
13000	Leucrocuta sp	MI		+					
13100	Nixe sp	MI		+					
13400	Stenacron sp	F		+					
13561	Maccaffertium pulchellum	MI		+					
13570	Maccaffertium terminatum	MI		+					
16700	Tricorythodes sp	MI		+					
18600	Ephemera sp	MI		+					
22001	Coenagrionidae	T		+					
22300	Argia sp	F		+					
23600	Aeshna sp	MT		+					
50315	Chimarra obscura	MI		+					
52200	Cheumatopsyche sp	F		+					
52430	Ceratopsyche morosa group	MI		+					
53400	Protoptila sp	I		+					
58505	Helicopsyche borealis	MI		+					
59415	Nectopsyche exquisita	MI		+					
59500	Oecetis sp	F		+					
59715				+					
59970	Petrophila sp	MI		+					
68075	Psephenus herricki	MI		+					
68901	Macronychus glabratus	F		+					
69400	Stenelmis sp	F		+					
74100	Simulium sp	F		+					
77800	Helopelopia sp	F		+					
81060	Lopescladius sp	MI		+					
81240	Nanocladius (N.) distinctus	MT		+					
82730	Chironomus (C.) decorus group	T		+					
84450	Polypedilum (Uresipedilum) flavum	F		+					
84470	Polypedilum (P.) illinoense	T		+					
84540	Polypedilum (Tripodura) scalaenum group	F		+					
85625	Rheotanytarsus sp	F		+					
85821	Tanytarsus glabrescens group sp 7	F		+					
93900	Elimia sp	MI		+					
96930	Laevapex fuscus	MT		+					
97601	Corbicula fluminea	F		+					

Appendix Table C-7. Macroinvertebrate taxa list for Olentangy River mainstem sites in 2022

River Code: **02-400** River: **Olentangy River** Coll. Date: *09/11/2022* RM: **2.00**

Site ID: **OLN02** Location: *ust. 5th. Ave.* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01320	Hydra sp	F		8	78655	Procladius (Holotanypus) sp	MT		+
01801	Turbellaria	F		871 +	81240	Nanocladius (N.) distinctus	MT		48
03000	Ectoprocta	F		+	82220	Tvetenia discoloripes group	MI		48 +
03600	Oligochaeta	T		+	82501	Chironomini			24
04901	Erpobdellidae	MT		+	82820	Cryptochironomus sp	F		+
04930	Erpobdella sp	MT		+	82822	Cryptochironomus eminentia	F		+
05900	Lirceus sp	MT		+	83000	Dicrotendipes sp	F		24
06201	Hyalella azteca	F		+	83040	Dicrotendipes neomodestus	F		+
08601	Hydrachnidia	F		+	83158	Endochironomus nigricans	MT		+
11119	Plauditus dubius or P. virilis	I		+	84450	Polypedilum (Uresipedilum) flavum	F	1662	+
11120	Baetis flavistriga	F		932 +	84470	Polypedilum (P.) illinoense	T		+
11130	Baetis intercalaris	F		+	84490	Polypedilum (Cerobregma) ontario	MI		+
12200	Isonychia sp	MI		51 +	84520	Polypedilum (Tripodura) halterale group	MT		+
13000	Leucrocuta sp	MI		+	84540	Polypedilum (Tripodura) scalaenum group	F		+
13400	Stenacron sp	F		50 +	85625	Rheotanytarsus sp	F	217	+
13510	Maccaffertium exiguum	MI		9 +	85800	Tanytarsus sp	F		+
13521	Stenonema femoratum	F		+	87501	Empididae	F		8
13561	Maccaffertium pulchellum	MI		53 +	87540	Hemerodromia sp	F		+
13570	Maccaffertium terminatum	MI		109 +	93900	Elimia sp	MI		+
16700	Tricorythodes sp	MI		112 +	96900	Ferrissia sp	F		+
18600	Ephemera sp	MI		+	97601	Corbicula fluminea	F		+
22001	Coenagrionidae	T		+	97710	Dreissena polymorpha	F		+
22300	Argia sp	F		+					
26700	Macromia sp	MI		+					
27001	Corduliidae			+					
45400	Trichocorixa sp	MT		+	No. Quantitative Taxa: 24		Total Taxa; 65		
50315	Chimarra obscura	MI		+	No. Qualitative Taxa: 57		ICI: 42		
51206	Cyrnellus fraternus	F		1	Number of Organisms: 6545		Qual EPT: 18		
52200	Cheumatopsyche sp	F		1479 +					
52430	Ceratopsyche morosa group	MI		763 +					
53400	Protoptila sp	I		+					
58505	Helicopsyche borealis	MI		+					
59415	Nectopsyche exquisita	MI		17 +					
59970	Petrophila sp	MI		+					
60900	Peltodytes sp	MT		+					
68075	Psephenus herricki	MI		+					
69400	Stenelmis sp	F		1 +					
72900	Culex sp	T		+					
74100	Simulium sp	F		26 +					
77120	Ablabesmyia mallochi	F		+					
77500	Conchapelopia sp	F		24					
77800	Helopelopia sp	F		+					
78450	Nilotanypus fimbriatus	F		8					

Appendix Table C-7. Macroinvertebrate taxa list for Olentangy River mainstem sites in 2022

River Code: **02-400** River: **Olentangy River** Coll. Date: *09/11/2022* RM: **1.70**

Site ID: **OLN03** Location: *dst. 5th. Ave., ust. 3rd. Ave.* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		1127 +	77800	Helopelopia sp	F		+
04964	Erpobdella microstoma	MT		+	78655	Procladius (Holotanypus) sp	MT		+
05800	Caecidotea sp	T		+	79100	Thienemannimyia group	F		46
05900	Lirceus sp	MT		+	81231	Nanocladius (N.) crassicornus or N. (N.) "rectinervis"	F		23
06201	Hyalella azteca	F		+	82820	Cryptochironomus sp	F		+
06700	Crangonyx sp	MT		+	83300	Glyptotendipes (G.) sp	MT		23
08250	Orconectes (Procericambarus) rusticus	F		+	84450	Polypedilum (Uresipedilum) flavum	F		1189 +
11130	Baetis intercalaris	F		323 +	84490	Polypedilum (Cerobregma) ontario	MI		69
12200	Isonychia sp	MI		5 +	84540	Polypedilum (Tripodura) scalaenum group	F		+
13000	Leucrocota sp	MI		+	84700	Stenochironomus sp	F		206
13100	Nixe sp	MI		+	85265	Cladotanytarsus vanderwulpi group sp 5	MI		+
13400	Stenacron sp	F		159 +	85625	Rheotanytarsus sp	F		389 +
13510	Maccaffertium exiguum	MI		172 +	87540	Hemerodromia sp	F		9
13550	Maccaffertium mexicanum integrum	MI		3	92615	Cipangopaludina japonica	MT		+
13561	Maccaffertium pulchellum	MI		283 +	93900	Elimia sp	MI		22 +
13570	Maccaffertium terminatum	MI		88 +	96900	Ferrissia sp	F		50
16700	Tricorythodes sp	MI		460 +	96930	Laevapex fuscus	MT		+
18100	Anthopotamus sp	MI		+	97601	Corbicula fluminea	F		2 +
18600	Ephemera sp	MI		+	97710	Dreissena polymorpha	F		+
21200	Calopteryx sp	F		+	98600	Sphaerium sp	F		+
21300	Hetaerina sp	F		1					
22001	Coenagrionidae	T		+					
22300	Argia sp	F		12 +	No. Quantitative Taxa: 31		Total Taxa; 60		
26700	Macromia sp	MI		+	No. Qualitative Taxa: 47		ICI: 38		
34715	Agnatina flavescens	I		1 +	Number of Organisms: 7230		Qual EPT: 16		
48410	Corydalus cornutus	MI		+					
51206	Cynellus fraternus	F		4					
52200	Cheumatopsyche sp	F		2258 +					
52430	Ceratopsyche morosa group	MI		278 +					
53400	Protoptila sp	I		+					
53800	Hydroptila sp	F		10					
59407	Nectopsyche candida	MI		+					
59715				+					
59970	Petrophila sp	MI		2 +					
68075	Psephenus herricki	MI		+					
68901	Macronychus glabratus	F		2					
69400	Stenelmis sp	F		12 +					
74100	Simulium sp	F		2					
77120	Ablabesmyia mallochi	F		+					
77750	Hayesomyia senata or Thienemannimyia norena	F		+					

Appendix Table C-7. Macroinvertebrate taxa list for Olentangy River mainstem sites in 2022

River Code: **02-400** River: **Olentangy River** Coll. Date: *09/16/2022* RM: **0.20**

Site ID: **OLN04** Location: *ust. I-670 bridge* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		634 +	80400	Cricotopus sp	F		31
01900	Nemertea	F		24	81825	Rheocricotopus (Psilocricotopus) robacki	F		31
03360	Plumatella sp	F		9	82220	Tvetenia discoloripes group	MI		93
03600	Oligochaeta	T		32 +	83040	Dicrotendipes neomodestus	F		+
04930	Erpobdella sp	MT		1	83300	Glyptotendipes (G.) sp	MT		31
05800	Caecidotea sp	T		1 +	84450	Polypedilum (Uresipedilum) flavum	F		1673 +
05900	Lirceus sp	MT		+	84460	Polypedilum (P.) fallax group	F		+
06201	Hyaella azteca	F		+	84470	Polypedilum (P.) illinoense	T		+
06700	Crangonyx sp	MT		+	84540	Polypedilum (Tripodura) scalaenum group	F		+
08601	Hydrachnidia	F		32	84700	Stenochironomus sp	F		31
11120	Baetis flavistriga	F		+	84800	Tribelos jucundum	MT		31
11130	Baetis intercalaris	F		1060 +	85265	Cladotanytarsus vanderwulpi group sp 5	MI		+
11650	Proclleon sp (w/ hindwing pads)	MI		+	85625	Rheotanytarsus sp	F		465 +
12200	Isonychia sp	MI		11	87540	Hemerodromia sp	F		80
13000	Leucrocuta sp	MI		+	93900	Elimia sp	MI		3
13400	Stenacron sp	F		120 +	95100	Physella sp	T		+
13561	Maccaffertium pulchellum	MI		195 +	96900	Ferrissia sp	F		+
13570	Maccaffertium terminatum	MI		126 +	96930	Laevapex fuscus	MT		24
16324	Teloganopsis deficiens	I		16	97601	Corbicula fluminea	F		6 +
16700	Tricorythodes sp	MI		501 +	98600	Sphaerium sp	F		8
18619	Ephemera simulans	MI		+					
21001	Calopterygidae	F		1					
22001	Coenagrionidae	T		+					
22300	Argia sp	F		+					
34715	Agnetina flavescens	I		1	No. Quantitative Taxa:	41	Total Taxa;		63
51206	Cyrnellus fraternus	F		1	No. Qualitative Taxa:	39	ICI:		42
52200	Cheumatopsyche sp	F		1412 +	Number of Organisms:	7122	Qual EPT:		15
52430	Ceratopsyche morosa group	MI		179 +					
52520	Hydropsyche bidens	MI		+					
52801	Potamyia flava	MI		49					
53400	Protoptila sp	I		+					
53800	Hydroptila sp	F		79 +					
59415	Nectopsyche exquisita	MI		+					
59970	Petrophila sp	MI		+					
68075	Psephenus herricki	MI		+					
68601	Ancyronyx variegata	F		1 +					
68901	Macronychus glabratus	F		1					
69400	Stenelmis sp	F		11 +					
74100	Simulium sp	F		8					
77120	Ablabesmyia mallochi	F		+					
77800	Helopelopia sp	F		62 +					
78450	Nilotanypus fimbriatus	F		32					
80363	Corynoneura sp 12	MI		16					

APPENDIX C: OLENTANGY TRIBUTARIES MACROINVERTEBRATE ASSEMBLAGE 2022

C-8: Olentangy Tributaries ICI Narrative Assessments 2022

C-9: Olentangy River Tributaries Macroinvertebrate Taxa Grand (all sites combined)

C-10: Olentangy Tributaries Macroinvertebrate Taxa by Site 2022

Appendix Table C-8. ICI metrics and narrative for tributary sites in Olentangy River study area sampled by MBI in 2022.

Site ID	River Mile	Drainage Area (sq mi)	Number of				Percent:				Qual. EPT	ICI or Narrative	
			Total Taxa ^a	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Mayflies	Caddisflies	Tany-tarsini	Other Dipt/NI			Tolerant Organisms
Adena Brook (02-401)													
Year:2022													
ADN04	1.60	1.80	29									3	P
ADN03	0.90	2.28	34									7	F
ADN02	0.70	2.66	38									6	F
ADN01	0.20	2.71	38									7	F
Turkey Run (02-402)													
Year:2022													
TUR01	0.70	2.09	24									2	P
Rush Run (02-403)													
Year:2022													
RSH01	0.20	2.62	23									5	P
Bartholomew Run (02-404)													
Year:2022													
BAR01	0.20	1.13	33									4	P
Wahalla Hollow (Ravine) (02-439)													
Year:2022													
WAH01	0.40	1.13	24									3	P
Tributary to Olentangy R. (RM 7.82) (Bull Moose Run) (02-440)													
Year:2022													
BMR01	0.20	2.69	29									6	F
Linworth Run (02-442)													
Year:2022													
LIN01	0.90	2.58	23									7	F
Glen Echo Ravine (02-465)													
Year:2022													
GER01	1.00	0.59	22									4	P
Tributary to Olentangy River @ RM 8.45 (02-492)													
Year:2022													
TRIB01	0.10	1.08	25									6	F

^a For HD samples represents total QUANT taxa, but for QUAL samples represents QUAL taxa.

Appendix C-9. Total macroinvertebrate taxa in the Olentangy River tributaries sampled by MBI during 2022.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	Qual. Samples
03600	<i>Oligochaeta</i>	T	N	8
74100	<i>Simulium sp</i>	F	D	8
84470	<i>Polypedilum (P.) illinoense</i>	T	D	8
01801	<i>Turbellaria</i>	F	N	7
11120	<i>Baetis flavistriga</i>	F	M	7
52200	<i>Cheumatopsyche sp</i>	F	C	7
79720	<i>Diamesa sp</i>	F	D	7
71900	<i>Tipula sp</i>	F	D	6
80740	<i>Eukiefferiella claripennis group</i>	MT	D	6
22300	<i>Argia sp</i>	F	O	5
52530	<i>Hydropsyche depravata group</i>	F	C	5
78350	<i>Meropelopia sp</i>	F	D	5
82820	<i>Cryptochironomus sp</i>	F	D	5
84210	<i>Paratendipes albimanus or P. duplicatus</i>	F	D	5
11130	<i>Baetis intercalaris</i>	F	M	4
21604	<i>Archilestes grandis</i>	T	O	4
51050	<i>Cernotina sp</i>	MI	C	4
53501	<i>Hydroptilidae</i>	F	C	4
77800	<i>Helopelopia sp</i>	F	D	4
81650	<i>Parametrioconemus sp</i>	F	D	4
84450	<i>Polypedilum (Uresipedilum) flavum</i>	F	D	4
05900	<i>Lirceus sp</i>	MT	N	3
50301	<i>Chimarra aterrima</i>	MI	C	3
69400	<i>Stenelmis sp</i>	F	O	3
77120	<i>Ablabesmyia mallochi</i>	F	D	3
80420	<i>Cricotopus (C.) bicinctus</i>	T	D	3
84300	<i>Phaenopsectra obediens group</i>	F	D	3
85500	<i>Paratanytarsus sp</i>	F	T	3
06201	<i>Hyalella azteca</i>	F	N	2
07800	<i>Cambarus sp</i>		N	2
13521	<i>Stenonema femoratum</i>	F	M	2
21200	<i>Calopteryx sp</i>	F	O	2
22001	<i>Coenagrionidae</i>	T	O	2
77250	<i>Alotanypus venustus</i>	VT	D	2
77500	<i>Conchapelopia sp</i>	F	D	2
80400	<i>Cricotopus sp</i>	F	D	2
80510	<i>Cricotopus (Isocladus) sylvestris group</i>	T	D	2
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	F	D	2
82730	<i>Chironomus (C.) decorus group</i>	T	D	2
84315	<i>Phaenopsectra flavipes</i>	MT	D	2

Appendix C-9 . continued.

Taxa Code	Taxa Name	Ohio EPA Tolerance	Taxa Group	Qual. Samples
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	F	D	2
87540	<i>Hemerodromia sp</i>	F	D	2
95100	<i>Physella sp</i>	T	N	2
96900	<i>Ferrissia sp</i>	F	N	2
98200	<i>Pisidium sp</i>	MT	N	2
04510	<i>Hirudinida</i>	MT	N	1
04660	<i>Helobdella sp</i>	MT	N	1
04901	<i>Erpobdellidae</i>	MT	N	1
04935	<i>Erpobdella punctata punctata</i>	MT	N	1
06700	<i>Crangonyx sp</i>	MT	N	1
08200	<i>Orconectes sp</i>	F	N	1
08601	<i>Hydrachnidia</i>	F	N	1
17200	<i>Caenis sp</i>	F	M	1
23600	<i>Aeshna sp</i>	MT	O	1
23700	<i>Anax sp</i>	MT	O	1
28500	<i>Libellula sp</i>	MT	O	1
51250	<i>Holocentropus sp</i>	F	C	1
66500	<i>Enochrus sp</i>	MT	O	1
67700	<i>Paracymus sp</i>	MT	O	1
68707	<i>Dubiraphia quadrinotata</i>	F	O	1
70600	<i>Antocha sp</i>	MI	D	1
71300	<i>Limonia sp</i>	F	D	1
72160	<i>Psychoda sp</i>	T	D	1
79400	<i>Zavrelimyia sp</i>	F	D	1
80350	<i>Corynoneura sp</i>		D	1
80430	<i>Cricotopus (C.) tremulus group</i>	MT	D	1
82824	<i>Cryptochironomus ponderosus</i>	F	D	1
83040	<i>Dicrotendipes neomodestus</i>	F	D	1
83840	<i>Microtendipes pedellus group</i>	F	D	1
84750	<i>Stictochironomus sp</i>	F	D	1
85001	<i>Tanytarsini</i>		T	1
85400	<i>Micropsectra sp</i>	MT	T	1
85625	<i>Rheotanytarsus sp</i>	F	T	1
85800	<i>Tanytarsus sp</i>	F	T	1
85840	<i>Tanytarsus sepp</i>	F	T	1
96120	<i>Menetus (Micromenetus) dilatatus</i>	MT	N	1
98001	<i>Pisidiidae</i>		N	1

Ohio EPA Tolerance Codes: I - Intolerant; MI - Moderately Intolerant; F - Facultative; MT - Moderately Tolerant; T - Tolerant

Appendix Table C-10. Macroinvertebrate taxa list for Olentangy River tributary sites in 2022

River Code: **02-401** River: **Adena Brook** Coll. Date: *06/16/2022* RM: **1.60**
 Site ID: **ADN04** Location: *Overbrook Dr. and Yaronia Dr.* Sample:

Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.
01801	Turbellaria	F	+				
03600	Oligochaeta	T	+				
04935	Erpobdella punctata punctata	MT	+				
11120	Baetis flavistriga	F	+				
21604	Archilestes grandis	T	+				
22001	Coenagrionidae	T	+				
22300	Argia sp	F	+				
23909	Boyeria vinosa	F	+				
52200	Cheumatopsyche sp	F	+				
52530	Hydropsyche depravata group	F	+				
70600	Antocha sp	MI	+				
71900	Tipula sp	F	+				
74100	Simulium sp	F	+				
77250	Alotanypus venustus	VT	+				
77800	Helopelopia sp	F	+				
78350	Meropelopia sp	X F	+				
79720	Diamesa sp	X F	+				
80430	Cricotopus (C.) tremulus group	MT	+				
80740	Eukiefferiella claripennis group	MT	+				
81650	Parametriocnemus sp	X F	+				
82770	Chironomus (C.) riparius group	T	+				
83003	Dicrotendipes fumidus	F	+				
84210	Paratendipes albimanus or P. duplicatus	F	+				
84450	Polypedilum (Uresipedilum) flavum	F	+				
84470	Polypedilum (P.) illinoense	T	+				
84540	Polypedilum (Tripodura) scalaenum group	F	+				
85500	Paratanytarsus sp	F	+				
95100	Physella sp	T	+				
96900	Ferrissia sp	F	+				

No. Quantitative Taxa: 0 Total Taxa; 29
 No. Qualitative Taxa: 29 ICI: P
 Number of Organisms: 0 Qual EPT: 3

Appendix Table C-10. Macroinvertebrate taxa list for Olentangy River tributary sites in 2022

River Code: **02-401** River: **Adena Brook** Coll. Date: *06/16/2022* RM: **0.90**

Site ID: **ADN03** Location: *Overbrook Dr., dst. Canyon Dr.* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria		F	+					
03600	Oligochaeta		T	+					
04935	Erpobdella punctata punctata		MT	+					
11120	Baetis flavistriga		F	+					
11130	Baetis intercalaris		F	+					
21604	Archilestes grandis		T	+					
22300	Argia sp		F	+					
23600	Aeshna sp		MT	+					
23909	Boyeria vinosa		F	+					
50301	Chimarra aterrima		MI	+					
51250	Holocentropus sp		F	+					
52200	Cheumatopsyche sp		F	+					
52530	Hydropsyche depravata group		F	+					
53800	Hydroptila sp		F	+					
70600	Antocha sp		MI	+					
71900	Tipula sp		F	+					
74100	Simulium sp		F	+					
77120	Ablabesmyia mallochi		F	+					
77500	Conchapelopia sp		F	+					
78350	Meropelopia sp	X	F	+					
79720	Diamesa sp	X	F	+					
80420	Cricotopus (C.) bicinctus		T	+					
80740	Eukiefferiella claripennis group		MT	+					
81650	Parametricnemus sp	X	F	+					
81825	Rheocricotopus (Psilocricotopus) robacki		F	+					
82770	Chironomus (C.) riparius group		T	+					
83003	Dicrotendipes fumidus		F	+					
84210	Paratendipes albimanus or P. duplicatus		F	+					
84470	Polypedilum (P.) illinoense		T	+					
84540	Polypedilum (Tripodura) scalaenum group		F	+					
85400	Micropsectra sp	X	MT	+					
85500	Paratanytarsus sp		F	+					
87540	Hemerodromia sp		F	+					
95100	Physella sp		T	+					

No. Quantitative Taxa: 0 Total Taxa; 34

No. Qualitative Taxa: 34 ICI: F

Number of Organisms: 0 Qual EPT: 7

Appendix Table C-10. Macroinvertebrate taxa list for Olentangy River tributary sites in 2022

River Code: **02-401** River: **Adena Brook** Coll. Date: *06/16/2022* RM: **0.70**

Site ID: **ADN02** Location: *dst. N. High St.* Sample:

Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.
01801	Turbellaria	F	+				
03600	Oligochaeta	T	+				
04664	Helobdella stagnalis	T	+				
04930	Erpobdella sp	MT	+				
11120	Baetis flavistriga	F	+				
11130	Baetis intercalaris	F	+				
21604	Archilestes grandis	T	+				
22300	Argia sp	F	+				
23600	Aeshna sp	MT	+				
50301	Chimarra aterrima	MI	+				
51600	Polycentropus sp	MI	+				
52200	Cheumatopsyche sp	F	+				
52530	Hydropsyche depravata group	F	+				
70600	Antocha sp	MI	+				
71300	Limonia sp	F	+				
71900	Tipula sp	F	+				
74100	Simulium sp	F	+				
77250	Alotanypus venustus	VT	+				
78350	Meropelopia sp	X F	+				
78655	Procladius (Holotanypus) sp	MT	+				
79720	Diamesa sp	X F	+				
80740	Eukiefferiella claripennis group	MT	+				
81650	Parametricnemus sp	X F	+				
82730	Chironomus (C.) decorus group	T	+				
82770	Chironomus (C.) riparius group	T	+				
82820	Cryptochironomus sp	F	+				
83000	Dicrotendipes sp	F	+				
84210	Paratendipes albimanus or P. duplicatus	F	+				
84300	Phaenopsectra obediens group	F	+				
84450	Polypedilum (Uresipedilum) flavum	F	+				
84470	Polypedilum (P.) illinoense	T	+				
84540	Polypedilum (Tripodura) scalaenum group	F	+				
85500	Paratanytarsus sp	F	+				
85625	Rheotanytarsus sp	F	+				
85800	Tanytarsus sp	F	+				
87540	Hemerodromia sp	F	+				
95100	Physella sp	T	+				
98200	Pisidium sp	MT	+				

No. Quantitative Taxa: 0 Total Taxa; 38
 No. Qualitative Taxa: 38 ICI: F
 Number of Organisms: 0 Qual EPT: 6

Appendix Table C-10. Macroinvertebrate taxa list for Olentangy River tributary sites in 2022

River Code: **02-401** River: **Adena Brook** Coll. Date: *06/20/2022* RM: **0.20**

Site ID: **ADN01** Location: *Park of Roses* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		+					
03600	Oligochaeta	T		+	No. Quantitative Taxa:	0	Total Taxa;		38
04930	Erpobdella sp	MT		+	No. Qualitative Taxa:	38	ICI:		F
06700	Crangonyx sp	MT		+	Number of Organisms:	0	Qual EPT:		7
08601	Hydrachnidia	F		+					
11120	Baetis flavistriga	F		+					
11130	Baetis intercalaris	F		+					
22001	Coenagrionidae	T		+					
22300	Argia sp	F		+					
23600	Aeshna sp	MT		+					
50301	Chimarra aterrima	MI		+					
51600	Polycentropus sp	MI		+					
52200	Cheumatopsyche sp	F		+					
52530	Hydropsyche depravata group	F		+					
53800	Hydroptila sp	F		+					
70600	Antocha sp	MI		+					
71900	Tipula sp	F		+					
74100	Simulium sp	F		+					
77120	Ablabesmyia mallochi	F		+					
77500	Conchapelopia sp	F		+					
77800	Helopelopia sp	F		+					
78350	Meropelopia sp	X	F	+					
79400	Zavrelimyia sp	X	F	+					
79720	Diamesa sp	X	F	+					
81650	Parametricnemus sp	X	F	+					
81825	Rheocricotopus (Psilocricotopus) robacki	F		+					
82820	Cryptochironomus sp	F		+					
84210	Paratendipes albimanus or P. duplicatus	F		+					
84440	Polypedilum (Uresipedilum) aviceps	X	MI	+					
84470	Polypedilum (P.) illinoense	T		+					
85500	Paratanytarsus sp	F		+					
85625	Rheotanytarsus sp	F		+					
85800	Tanytarsus sp	F		+					
85840	Tanytarsus sepp	F		+					
87540	Hemerodromia sp	F		+					
95100	Physella sp	T		+					
96900	Ferrissia sp	F		+					
98200	Pisidium sp	MT		+					

Appendix Table C-10. Macroinvertebrate taxa list for Olentangy River tributary sites in 2022

River Code: **02-402** River: **Turkey Run** Coll. Date: *06/20/2022* RM: **0.70**

Site ID: **TUR01** Location: *ust. Tillbury Ave.* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		+					
03600	Oligochaeta	T		+					
04660	Helobdella sp	MT		+					
04935	Erpobdella punctata punctata	MT		+					
06201	Hyalella azteca	F		+					
08601	Hydrachnidia	F		+					
17200	Caenis sp	F		+					
22300	Argia sp	F		+					
53501	Hydroptilidae	F		+					
71900	Tipula sp	F		+					
74100	Simulium sp	F		+					
77800	Helopelopia sp	F		+					
78350	Meropelopia sp	X	F	+					
80420	Cricotopus (C.) bicinctus	T		+					
80510	Cricotopus (Isocladius) sylvestris group	T		+					
81650	Parametriocnemus sp	X	F	+					
83040	Dicrotendipes neomodestus	F		+					
84210	Paratendipes albimanus or P. duplicatus	F		+					
84300	Phaenopsectra obediens group	F		+					
84450	Polypedilum (Uresipedilum) flavum	F		+					
84470	Polypedilum (P.) illinoense	T		+					
85001	Tanytarsini			+					
96120	Menetus (Micromenetus) dilatatus	MT		+					
96900	Ferrissia sp	F		+					

No. Quantitative Taxa: 0 Total Taxa; 24

No. Qualitative Taxa: 24 ICI: P

Number of Organisms: 0 Qual EPT: 2

Appendix Table C-10. Macroinvertebrate taxa list for Olentangy River tributary sites in 2022

River Code: **02-403** River: **Rush Run** Coll. Date: *06/20/2022* RM: **0.20**

Site ID: **RSH01** Location: *ust. confluence with Olentangy River* Sample:

Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.
01801	Turbellaria	F	+				
03600	Oligochaeta	T	+				
06201	Hyalella azteca	F	+				
06700	Crangonyx sp	MT	+				
11120	Baetis flavistriga	F	+				
11130	Baetis intercalaris	F	+				
22300	Argia sp	F	+				
52200	Cheumatopsyche sp	F	+				
52530	Hydropsyche depravata group	F	+				
53501	Hydroptilidae	F	+				
70600	Antocha sp	MI	+				
71900	Tipula sp	F	+				
74100	Simulium sp	F	+				
77120	Ablabesmyia mallochi	F	+				
78350	Meropelopia sp	X F	+				
79720	Diamesa sp	X F	+				
80420	Cricotopus (C.) bicinctus	T	+				
80740	Eukiefferiella claripennis group	MT	+				
81825	Rheocricotopus (Psilocricotopus) robacki	F	+				
82820	Cryptochironomus sp	F	+				
84470	Polypedilum (P.) illinoense	T	+				
87540	Hemerodromia sp	F	+				
95100	Physella sp	T	+				

No. Quantitative Taxa: 0 Total Taxa; 23
 No. Qualitative Taxa: 23 ICI: P
 Number of Organisms: 0 Qual EPT: 5

Appendix Table C-10. Macroinvertebrate taxa list for Olentangy River tributary sites in 2022

River Code: **02-404** River: **Bartholomew Run** Coll. Date: *06/22/2022* RM: **0.20**

Site ID: **BAR01** Location: *ust. Bennett Parkway* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria		F	+					
03600	Oligochaeta		T	+					
04901	Erpobdellidae		MT	+					
05900	Lirceus sp		MT	+					
08200	Orconectes sp		F	+					
11120	Baetis flavistriga		F	+					
13521	Stenonema femoratum		F	+					
21604	Archilestes grandis		T	+					
22001	Coenagrionidae		T	+					
22300	Argia sp		F	+					
23600	Aeshna sp		MT	+					
50301	Chimarra aterrima		MI	+					
51250	Holocentropus sp		F	+					
52200	Cheumatopsyche sp		F	+					
68707	Dubiraphia quadrinotata		F	+					
69400	Stenelmis sp		F	+					
71900	Tipula sp		F	+					
74100	Simulium sp		F	+					
77800	Helopelopia sp		F	+					
79720	Diamesa sp	X	F	+					
80740	Eukiefferiella claripennis group		MT	+					
81650	Parametriocnemus sp	X	F	+					
82730	Chironomus (C.) decorus group		T	+					
82820	Cryptochironomus sp		F	+					
82824	Cryptochironomus ponderosus		F	+					
84210	Paratendipes albimanus or P. duplicatus		F	+					
84450	Polypedilum (Uresipedilum) flavum		F	+					
84470	Polypedilum (P.) illinoense		T	+					
84540	Polypedilum (Tripodura) scalaenum group		F	+					
84750	Stictoichironomus sp		F	+					
85500	Paratanytarsus sp		F	+					
85625	Rheotanytarsus sp		F	+					
95100	Physella sp		T	+					
98001	Pisidiidae			+					

No. Quantitative Taxa: 0 Total Taxa; 34

No. Qualitative Taxa: 34 ICI: P

Number of Organisms: 0 Qual EPT: 4

Appendix Table C-10. Macroinvertebrate taxa list for Olentangy River tributary sites in 2022

River Code: **02-439** River: *Wahalla Hollow (Ravine)* Coll. Date: *06/21/2022* RM: **0.40**

Site ID: **WAH01** Location: *Wahalla Rd.* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria		F	+					
03600	Oligochaeta		T	+					
05900	Lirceus sp		MT	+					
07800	Cambarus sp			+					
11120	Baetis flavistriga		F	+					
21604	Archilestes grandis		T	+					
51050	Cernotina sp		MI	+					
52200	Cheumatopsyche sp		F	+					
67700	Paracymus sp		MT	+					
71300	Limonia sp		F	+					
71900	Tipula sp		F	+					
74100	Simulium sp		F	+					
78350	Meropelopia sp	X	F	+					
79400	Zavrelimyia sp	X	F	+					
79720	Diamesa sp	X	F	+					
80350	Corynoneura sp			+					
80400	Cricotopus sp		F	+					
80740	Eukiefferiella claripennis group		MT	+					
84210	Paratendipes albimanus or P. duplicatus		F	+					
84315	Phaenopsectra flavipes		MT	+					
84470	Polypedilum (P.) illinoense		T	+					
84540	Polypedilum (Tripodura) scalaenum group		F	+					
85800	Tanytarsus sp		F	+					
98200	Pisidium sp		MT	+					

No. Quantitative Taxa: 0 Total Taxa; 24

No. Qualitative Taxa: 24 ICI: P

Number of Organisms: 0 Qual EPT: 3

Appendix Table C-10. Macroinvertebrate taxa list for Olentangy River tributary sites in 2022

River Code: **02-440** River: *Tributary to Olentangy R. (RM 7.82) (Bull Moose)* Coll. Date: *06/21/2022* RM: **0.20**
 Site ID: **BMR01** Location: *ust. Confluence with Olentangy R. Kenny Park* Sample:

Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.
03600	Oligochaeta	T	+				
07800	Cambarus sp		+				
11120	Baetis flavistriga	F	+				
11130	Baetis intercalaris	F	+				
21200	Calopteryx sp	F	+				
22300	Argia sp	F	+				
28500	Libellula sp	MT	+				
50301	Chimarra aterrima	MI	+				
51050	Cernotina sp	MI	+				
52200	Cheumatopsyche sp	F	+				
52530	Hydropsyche depravata group	F	+				
69400	Stenelmis sp	F	+				
74100	Simulium sp	F	+				
77120	Ablabesmyia mallochi	F	+				
77800	Helopelopia sp	F	+				
79720	Diamesa sp	X F	+				
80740	Eukiefferiella claripennis group	MT	+				
81650	Parametriocnemus sp	X F	+				
81825	Rheocricotopus (Psilocricotopus) robacki	F	+				
82820	Cryptochironomus sp	F	+				
84210	Paratendipes albimanus or P. duplicatus	F	+				
84300	Phaenopsectra obediens group	F	+				
84450	Polypedilum (Uresipedilum) flavum	F	+				
84470	Polypedilum (P.) illinoense	T	+				
85400	Micropsectra sp	X MT	+				
85500	Paratanytarsus sp	F	+				
85840	Tanytarsus sepp	F	+				
87540	Hemerodromia sp	F	+				
96900	Ferrissia sp	F	+				

No. Quantitative Taxa: 0 Total Taxa; 29
 No. Qualitative Taxa: 29 ICI: F
 Number of Organisms: 0 Qual EPT: 6

Appendix Table C-10. Macroinvertebrate taxa list for Olentangy River tributary sites in 2022

River Code: **02-442** River: *Linworth Run* Coll. Date: *06/21/2022* RM: **0.90**

Site ID: **LIN01** Location: *ust. Linworth Rd.* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria	F		+					
03600	Oligochaeta	T		+					
05900	Lirceus sp	MT		+					
11120	Baetis flavistriga	F		+					
11130	Baetis intercalaris	F		+					
13521	Stenonema femoratum	F		+					
21200	Calopteryx sp	F		+					
50301	Chimarra aterrima	MI		+					
51050	Cernotina sp	MI		+					
52200	Cheumatopsyche sp	F		+					
52530	Hydropsyche depravata group	F		+					
69400	Stenelmis sp	F		+					
74100	Simulium sp	F		+					
77120	Ablabesmyia mallochi	F		+					
77500	Conchapelopia sp	F		+					
77800	Helopelopia sp	F		+					
79720	Diamesa sp	X F		+					
80740	Eukiefferiella claripennis group	MT		+					
82820	Cryptochironomus sp	F		+					
83840	Microtendipes pedellus group	F		+					
84300	Phaenopsectra obediens group	F		+					
84450	Polypedilum (Uresipedilum) flavum	F		+					
84470	Polypedilum (P.) illinoense	T		+					

No. Quantitative Taxa: 0 Total Taxa; 23
 No. Qualitative Taxa: 23 ICI: F
 Number of Organisms: 0 Qual EPT: 7

Appendix Table C-10. Macroinvertebrate taxa list for Olentangy River tributary sites in 2022

River Code: **02-465** River: *Glen Echo Ravine* Coll. Date: *06/23/2022* RM: **1.00**

Site ID: **GER01** Location: *Glen Echo Park* Sample:

Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.
01801	Turbellaria	F	+				
03600	Oligochaeta	T	+				
04510	Hirudinida	MT	+				
11120	Baetis flavistriga	F	+				
21604	Archilestes grandis	T	+				
52200	Cheumatopsyche sp	F	+				
52530	Hydropsyche depravata group	F	+				
53501	Hydroptilidae	F	+				
66500	Enochrus sp	MT	+				
71900	Tipula sp	F	+				
72160	Psychoda sp	T	+				
74100	Simulium sp	F	+				
77250	Alotanypus venustus	VT	+				
78350	Meropelopia sp	X F	+				
79720	Diamesa sp	X F	+				
80400	Cricotopus sp	F	+				
80420	Cricotopus (C.) bicinctus	T	+				
80430	Cricotopus (C.) tremulus group	MT	+				
80510	Cricotopus (Isocladius) sylvestris group	T	+				
80740	Eukiefferiella claripennis group	MT	+				
82730	Chironomus (C.) decorus group	T	+				
84470	Polypedilum (P.) illinoense	T	+				

No. Quantitative Taxa: 0 Total Taxa; 22

No. Qualitative Taxa: 22 ICI: P

Number of Organisms: 0 Qual EPT: 4

Appendix Table C-10. Macroinvertebrate taxa list for Olentangy River tributary sites in 2022

River Code: **02-492** River: *Tributary to Olentangy River @ RM 8.45* Coll. Date: *06/22/2023* RM: **0.10**

Site ID: **TRIB01** Location: *dst. OH-315* Sample:

Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.	Taxa Code	Taxa	CWH Taxa Tol.	Qt./Ql.
01801	Turbellaria	F	+				
03600	Oligochaeta	T	+				
11120	Baetis flavistriga	F	+				
11130	Baetis intercalaris	F	+				
21604	Archilestes grandis	T	+				
22001	Coenagrionidae	T	+				
22300	Argia sp	F	+				
23700	Anax sp	MT	+				
51050	Cernotina sp	MI	+				
52200	Cheumatopsyche sp	F	+				
52530	Hydropsyche depravata group	F	+				
53501	Hydroptilidae	F	+				
71900	Tipula sp	F	+				
74100	Simulium sp	F	+				
77250	Alotanypus venustus	VT	+				
77500	Conchapelopia sp	F	+				
78350	Meropelopia sp	X F	+				
79720	Diamesa sp	X F	+				
81650	Parametricnemus sp	X F	+				
82820	Cryptochironomus sp	F	+				
84210	Paratendipes albimanus or P. duplicatus	F	+				
84315	Phaenopsectra flavipes	MT	+				
84470	Polypedilum (P.) illinoense	T	+				
85500	Paratanytarsus sp	F	+				
98200	Pisidium sp	MT	+				

No. Quantitative Taxa: 0 Total Taxa; 25

No. Qualitative Taxa: 25 ICI: F

Number of Organisms: 0 Qual EPT: 6

APPENDIX D-1: Scioto_Olentangy River Mainstem and Tributaries QHEI Metrics 2022

Appendix D-1. QHEI metric scores for sites in the Scioto River study area in 2022.

River Mile	QHEI Metrics								Narrative
	QHEI	Substrate	Cover	Channel	Riparian	Pool	Riffle	Gradient/ Score	
<i>02-001 Scioto River</i>									
Year: 2022									
136.05	88.00	18.0	17.0	17.0	6.0	12.0	8.0	4.53 - (10)	Excellent
133.40	84.00	14.5	18.0	18.0	3.5	13.0	8.0	2.23 - (10)	Excellent
133.00	87.00	18.0	17.0	19.5	3.5	11.0	8.0	2.23 - (10)	Excellent
132.10	68.50	14.0	15.0	13.0	4.5	13.0	0.0	6.10 - (10)	Good
130.40	57.00	14.0	15.0	6.0	5.0	7.0	0.0	6.50 - (10)	Fair
129.40	86.25	16.0	17.0	17.5	5.7	12.0	8.0	1.80 - (10)	Excellent
127.70	85.50	16.0	16.0	17.5	6.0	12.0	8.0	1.80 - (10)	Excellent
127.40	62.00	14.0	15.0	11.0	5.0	7.0	0.0	1.80 - (10)	Good
126.55	85.00	18.0	17.0	17.5	4.5	11.0	7.0	1.80 - (10)	Excellent
125.20	61.50	14.0	15.0	11.0	4.5	7.0	0.0	1.80 - (10)	Good
124.40	80.25	16.0	17.0	16.5	4.2	11.0	5.5	1.80 - (10)	Excellent
120.10	86.00	16.0	17.0	18.0	5.5	13.0	7.5	1.60 - (10)	Excellent
118.00	72.50	16.0	17.0	16.0	4.5	9.0	0.0	1.60 - (10)	Good
117.15	84.00	16.0	17.0	18.0	5.0	12.0	6.0	1.70 - (10)	Excellent
116.00	86.50	16.5	17.0	20.0	4.0	11.0	8.0	1.70 - (10)	Excellent
114.00	84.50	16.0	17.0	18.0	5.0	12.0	6.5	1.70 - (10)	Excellent
109.35	84.00	16.0	18.0	18.5	6.0	11.0	6.5	1.00 - (8)	Excellent
107.50	77.00	16.0	17.0	15.5	5.5	11.0	4.0	1.00 - (8)	Excellent
105.25	79.75	16.0	14.0	18.5	5.2	12.0	6.0	1.00 - (8)	Excellent
102.00	81.50	16.0	15.0	18.5	4.5	13.0	7.5	1.00 - (8)	Excellent
100.24	93.50	18.0	20.0	18.5	8.0	11.0	8.0	1.70 - (10)	Excellent
99.52	89.75	18.0	17.0	20.0	5.7	11.0	8.0	1.70 - (10)	Excellent
98.65	74.50	18.0	17.0	13.5	7.0	9.0	0.0	1.70 - (10)	Good
<i>02-100 Big Walnut Creek</i>									
Year: 2022									
9.80	83.50	16.0	18.0	18.0	4.5	12.0	7.0	2.60 - (8)	Excellent
<i>02-400 Olentangy River</i>									
Year: 2022									
14.90	78.00	14.0	17.0	17.0	4.5	11.0	6.5	13.90 - (8)	Excellent
12.90	76.50	16.0	16.0	14.5	7.0	8.0	5.0	5.78 - (10)	Excellent
12.30	79.00	17.0	17.0	14.0	6.5	10.0	6.5	2.91 - (8)	Excellent
8.50	82.50	18.0	16.0	16.0	5.5	11.0	8.0	2.91 - (8)	Excellent
7.10	82.50	17.0	17.0	16.5	5.0	12.0	7.0	2.59 - (8)	Excellent
5.82	54.50	14.5	14.0	5.0	6.0	7.0	0.0	2.59 - (8)	Fair
4.45	58.00	14.5	16.0	6.0	6.5	7.0	0.0	2.59 - (8)	Fair
3.95	78.75	17.0	16.0	13.5	4.7	12.0	7.5	2.63 - (8)	Excellent

Appendix D-1. QHEI metric scores for sites in the Scioto River study area in 2022.

River Mile	QHEI Metrics								Narrative
	QHEI	Substrate	Cover	Channel	Riparian	Pool	Riffle	Gradient/ Score	
2.00	75.00	18.0	13.0	14.0	5.0	10.0	7.0	3.86 - (8)	Excellent
1.80	85.25	17.5	16.0	17.5	4.7	12.0	7.5	4.34 - (10)	Excellent
0.20	78.50	18.0	13.0	14.0	4.5	11.0	8.0	4.34 - (10)	Excellent

Appendix D-1. QHEI metric scores for sites in the Olentangy river tributaries study area in 2022.

River Mile	QHEI	QHEI Metrics:						Gradient & Score	Narrative
		Substrate	Cover	Channel	Riparian	Pool	Riffle		
(02401) Adena Brook									
Year:2022									
1.70	76.00	18.5	16.0	13.5	5.00	10.0	5.0	40.00 - (8)	Excellent
0.80	60.50	16.5	14.0	11.0	6.00	6.0	3.0	47.60 - (4)	Good
0.52	57.25	16.5	9.0	11.0	5.25	4.0	3.5	40.00 - (8)	Fair
0.23	75.50	18.5	16.0	13.0	6.50	8.0	3.5	22.20 - (10)	Excellent
(02402) Turkey Run									
Year:2022									
0.70	69.50	17.5	14.0	11.0	5.00	6.0	6.0	26.30 - (10)	Good
(02403) Rush Run									
Year:2022									
0.24	72.00	18.5	16.0	14.0	6.00	8.0	5.5	62.50 - (4)	Excellent
(02404) Bartholomew Run									
Year:2022									
0.20	63.50	13.5	14.0	15.0	6.00	6.0	5.0	52.60 - (4)	Good
(02439) Walhalla Ravine									
Year:2022									
1.00	47.00	16.0	7.0	11.0	5.00	4.0	0.0	52.60 - (4)	Fair
(02440) Trib. to Olentangy R. (RM 7.82) (Bull Moose Run)									
Year:2022									
0.20	70.50	18.5	14.0	11.0	6.00	5.0	6.0	24.40 - (10)	Excellent
(02442) Linworth Run									
Year:2022									
0.80	63.00	18.5	13.0	11.0	6.00	5.0	5.5	58.80 - (4)	Good
(02465) Glen Echo Ravine									
Year:2022									
0.95	57.00	13.0	12.0	12.0	6.00	6.0	4.0	142.9 - (4)	Fair
(02492) Tributary to Olentangy River @ RM 8.45									
Year:2022									
0.10	65.50	19.0	13.0	13.5	5.00	5.0	6.0	50.00 - (4)	Good

APPENDIX D-2: Scioto_Olentangy River Mainstem and Tributaries QHEI Field Sheets 2022

Stream & Location: Scioto River Dist 5th Ave

RM: 136.05 Date: 8/17/2022

Stol

Scorers Full Name & Affiliation: NBI-MAS

River Code: 02-001 - STORET#:

Lat./Long.: 39.9825 183.0653

Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Check ONE (Or 2 & average)

Substrate assessment table with categories: BEST TYPES, OTHER TYPES, ORIGIN, POOL RIFFLE, SILT, EMBEDDEDNESS, QUALITY. Includes checkboxes for various substrate types and a score box for Substrate (18).

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

AMOUNT

Check ONE (Or 2 & average)

Instream Cover assessment table with categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS (IN SLOW WATER), ROOTMATS, POOLS > 70cm, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes checkboxes for amount levels and a score box for Cover (11).

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel Morphology assessment table with categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes checkboxes for various channel characteristics and a score box for Channel (17).

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Bank Erosion and Riparian Zone assessment table with categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY, CONSERVATION TILLAGE, URBAN OR INDUSTRIAL, MINING / CONSTRUCTION. Includes checkboxes for various bank and riparian characteristics and a score box for Riparian (6).

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

Pool / Glide and Riffle / Run Quality assessment table with categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY, Recreation Potential. Includes checkboxes for various pool and riffle characteristics and a score box for Pool / Current (12).

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Check ONE (Or 2 & average).

NO RIFFLE [metric=0]

Riffle / Run Quality assessment table with categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes checkboxes for various riffle and run characteristics and a score box for Riffle / Run (8).

6] GRADIENT (4.53 ft/mi) DRAINAGE AREA (1050 mi^2)

%POOL: %GLIDE: %RUN: %RIFFLE:

Gradient Maximum 10

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

1st-sample pass-- 2nd

CLARITY

- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%- CLOSED

1st 2nd

cm cm

CJ RECREATION

AREA DEPTH POOL: >100ft² >3ft

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Scioto River Dst Dublin Rd Dam RM: 133.4 Date: 8/11/2022

River Code: 02-001 STORET#: Lat/Long: 39.9655 183.0325 Office verified location

Scorers Full Name & Affiliation: MBI-MAS

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. Check ONE (Or 2 & average). BEST TYPES: BLDR/SLABS [10], BOULDER [9], COBBLE [8], GRAVEL [7], SAND [6], BEDROCK [5]. OTHER TYPES: HARDPAN [4], DETRITUS [3], MUCK [2], SILT [2], ARTIFICIAL [0]. ORIGIN: LIMESTONE [1], TILLS [1], WETLANDS [0], HARDPAN [0], SANDSTONE [0], RIP/RAP [0], LACUSTURINE [0], SHALE [-1], COAL FINES [-2]. QUALITY: HEAVY [-2], MODERATE [-1], NORMAL [0], FREE [1], EXTENSIVE [-2], MODERATE [-1], NORMAL [0], NONE [1].

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts. AMOUNT: EXTENSIVE >75% [11], MODERATE 25-75% [7], SPARSE 5-<25% [3], NEARLY ABSENT <5% [1].

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). SINUOSITY: HIGH [4], MODERATE [3], LOW [2], NONE [1]. DEVELOPMENT: EXCELLENT [7], GOOD [5], FAIR [3], POOR [1]. CHANNELIZATION: NONE [6], RECOVERED [4], RECOVERING [3], RECENT OR NO RECOVERY [1]. STABILITY: HIGH [3], MODERATE [2], LOW [1].

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). RIPARIAN WIDTH: WIDE > 50m [4], MODERATE 10-50m [3], NARROW 5-10m [2], VERY NARROW < 5m [1], NONE [0]. FLOOD PLAIN QUALITY: FOREST, SWAMP [3], SHRUB OR OLD FIELD [2], RESIDENTIAL, PARK, NEW FIELD [1], FENCED PASTURE [1], OPEN PASTURE, ROWCROP [0]. CONSERVATION TILLAGE [1], URBAN OR INDUSTRIAL [0], MINING / CONSTRUCTION [0].

5] POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH: > 1m [6], 0.7-<1m [4], 0.4-<0.7m [2], 0.2-<0.4m [1], < 0.2m [0]. CHANNEL WIDTH: POOL WIDTH > RIFFLE WIDTH [2], POOL WIDTH = RIFFLE WIDTH [1], POOL WIDTH < RIFFLE WIDTH [0]. CURRENT VELOCITY: TORRENTIAL [-1], VERY FAST [1], FAST [1], MODERATE [1], SLOW [1], INTERSTITIAL [-1], INTERMITTENT [-2], EDDIES [1].

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: RIFFLE DEPTH: BEST AREAS > 10cm [2], BEST AREAS 5-10cm [1], BEST AREAS < 5cm [metric=0]. RUN DEPTH: MAXIMUM > 50cm [2], MAXIMUM < 50cm [1]. RIFFLE / RUN SUBSTRATE: STABLE (e.g., Cobble, Boulder) [2], MOD. STABLE (e.g., Large Gravel) [1], UNSTABLE (e.g., Fine Gravel, Sand) [0]. RIFFLE / RUN EMBEDDEDNESS: NONE [2], LOW [1], MODERATE [0], EXTENSIVE [-1].

6] GRADIENT (2.23 ft/mi) DRAINAGE AREA (1070 mi^2) VERY LOW - LOW [2-4], MODERATE [6-10], HIGH - VERY HIGH [10-6]. %POOL: ? %GLIDE: %RUN: %RIFFLE:

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

A) SAMPLED REACH
Check ALL that apply

- METHOD**
- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY
- DISTANCE**
- 0.5 Km
 - 0.2 Km
 - 0.15 Km
 - 0.12 Km
 - OTHER

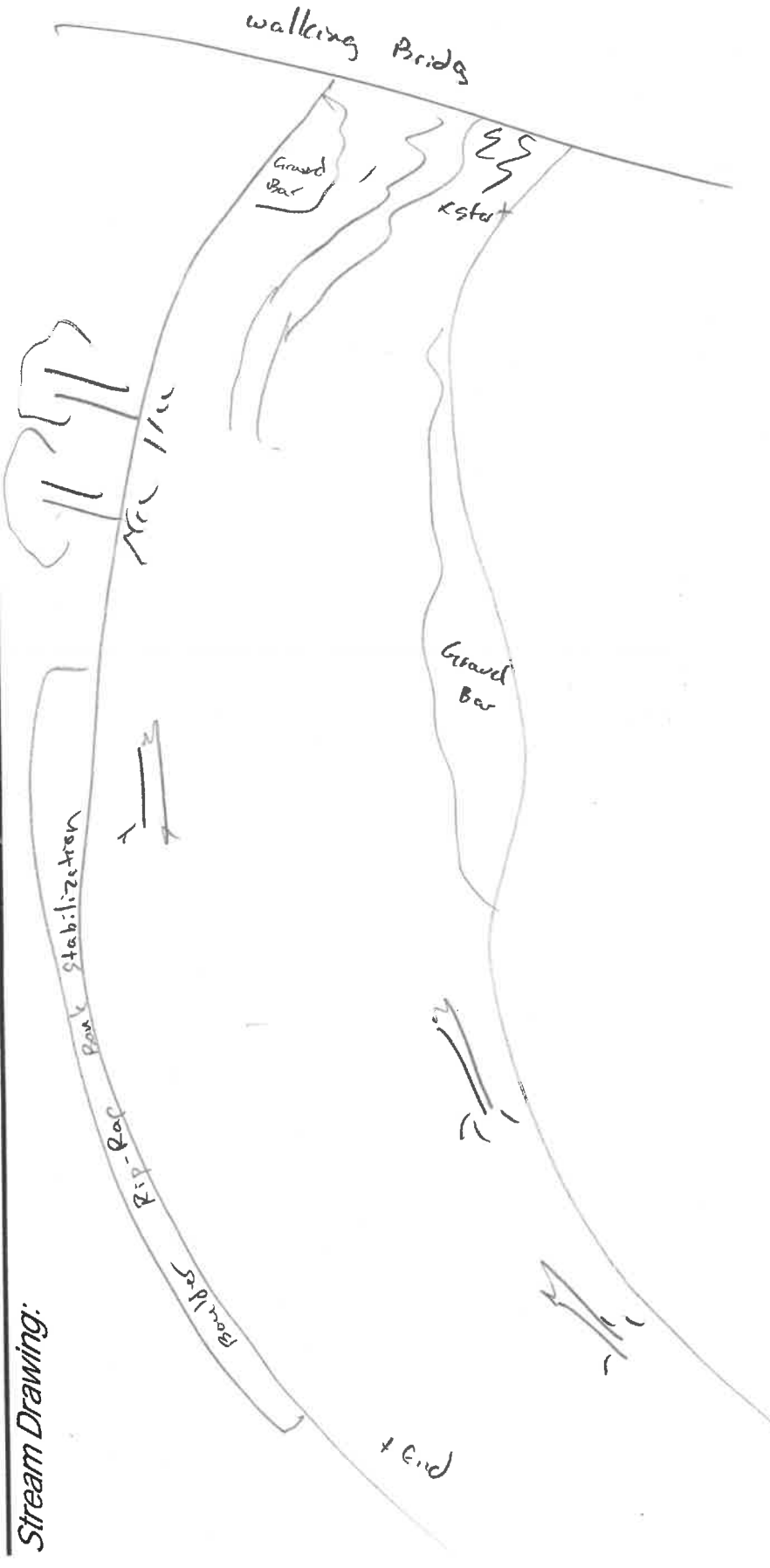
- CLARITY**
- 1st --sample pass-- 2nd
- < 20 cm
 - 20-<40 cm
 - 40-70 cm
 - > 70 cm/CTB
- SECCHI DEPTH**
- 1st _____ cm
- 2nd _____ cm
- CANOPY**
- > 85% - OPEN
 - 55%-<85%
 - 30%-<55%
 - 10%-<30%
 - <10% - CLOSED

(beg) 39.96714, -83.63408
(middle) 39.965521, -83.03255 7
(end) 39.96482, -83.62972

DJ MAINTENANCE	EJ ISSUES	FJ MEASUREMENTS
<input type="checkbox"/> PUBLIC / PRIVATE / BOTH / NA <input type="checkbox"/> ACTIVE / HISTORIC / BOTH / NA <input type="checkbox"/> YOUNG-SUCCESSION-OLD <input type="checkbox"/> SPRAY / SNAG / REMOVED <input type="checkbox"/> MODIFIED / DIPPED OUT / NA <input type="checkbox"/> LEVEED / ONE SIDED <input type="checkbox"/> RELOCATED / CUTOFFS <input type="checkbox"/> MOVING-BEDLOAD-STABLE <input type="checkbox"/> ARMoured / SLUMPS <input type="checkbox"/> ISLANDS / SCoured <input type="checkbox"/> IMPOUNDED / DESICCATED <input type="checkbox"/> FLOOD CONTROL / DRAINAGE	WWTP / CSO / NPDES / INDUSTRY HARDENED / URBAN / DIRT&GRIME CONTAMINATED / LANDFILL BMPs-CONSTRUCTION-SEDIMENT LOGGING / IRRIGATION / COOLING BANK / EROSION / SURFACE FALSE BANK / MANURE / LAGOON WASH H ₂ O / TILE / H ₂ O TABLE ACID / MINE / QUARRY / FLOW NATURAL / WETLAND / STAGNANT PARK / GOLF / LAWN / HOME ATMOSPHERE / DATA PAUCITY	x̄ width x̄ depth max. depth x̄ bankfull width bankfull x̄ depth W/D ratio bankfull max. depth floodprone x̄ width entrench. ratio <i>Legacy Tree:</i>

- BJAESTHETICS**
- NUISANCE ALGAE
 - INVASIVE MACROPHYTES
 - EXCESS TURBIDITY
 - DISCOLORATION
 - FOAM / SCUM
 - OIL SHEEN
 - TRASH / LITTER
 - NUISANCE ODOR
 - SLUDGE DEPOSITS
 - CSOs/SSOs/OUTFALLS
- CJ RECREATION** AREA DEPTH
- POOL: >100ft² >3ft

Stream Drawing:



Stream & Location: Scioto River dst. 1-670 RM: 133.0 Date: 8/1/2022

S203 Scorers Full Name & Affiliation: MBI-MAS River Code: 02-001 STORET #: Lat./Long.: 39 183 Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. Includes categories: BEST TYPES, OTHER TYPES, ORIGIN, and QUALITY. Includes a 'Substrate' score box with value 18.

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts... Includes categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes an 'Amount' score box with value 17.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). Includes categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes a 'Channel' score box with value 19.5.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). Includes categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes a 'Riparian' score box with value 3.5.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY. Includes a 'Recreation Potential' box and a 'Pool/Current' score box with value 11.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species. Includes categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes a 'Riffle/Run' score box with value 8.

6) GRADIENT (2.23 ft/mi) DRAINAGE AREA (1070 mi^2). Includes categories: VERY LOW - LOW, MODERATE, HIGH - VERY HIGH. Includes a 'Gradient' score box with value 10.

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

A) SAMPLED REACH
Check ALL that apply

- METHOD**
- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

- DISTANCE**
- 0.5 Km
 - 0.2 Km
 - 0.15 Km
 - 0.12 Km
 - OTHER
- CLARITY**
- < 20 cm
 - 20-40 cm
 - 40-70 cm
 - > 70 cm/ CTB
- SECCHI DEPTH**
- 1st cm
 - 2nd cm
- CANOPY**
- > 85% - OPEN
 - 55% - 85%
 - 30% - 55%
 - 10% - 30%
 - < 10% - CLOSED

- BIJAESTHETICS**
- NUISANCE ALGAE
 - INVASIVE MACROPHYTES
 - EXCESS TURBIDITY
 - DISCOLORATION
 - FOAM / SCUM
 - OIL SHEEN
 - TRASH / LITTER
 - NUISANCE ODOR
 - SLUDGE DEPOSITS
 - CSOs/SSOs/OUTFALLS
- AREA DEPTH**
- POOL: >100ft² >3ft

- D) MAINTENANCE**
- PUBLIC / PRIVATE / BOTH / NA
 - ACTIVE / HISTORIC / BOTH / NA
 - YOUNG-SUCCESSION-OLD
 - SPRAY / SNAG / REMOVED
 - MODIFIED / DIPPED OUT / NA
 - LEVEED / ONE SIDED
 - RELOCATED / CUTOFFS
 - MOVING-BEDLOAD-STABLE
 - ARMoured / SLUMPS
 - ISLANDS / SCOURED
 - IMPOUNDED / DESICCATED
 - FLOOD CONTROL / DRAINAGE

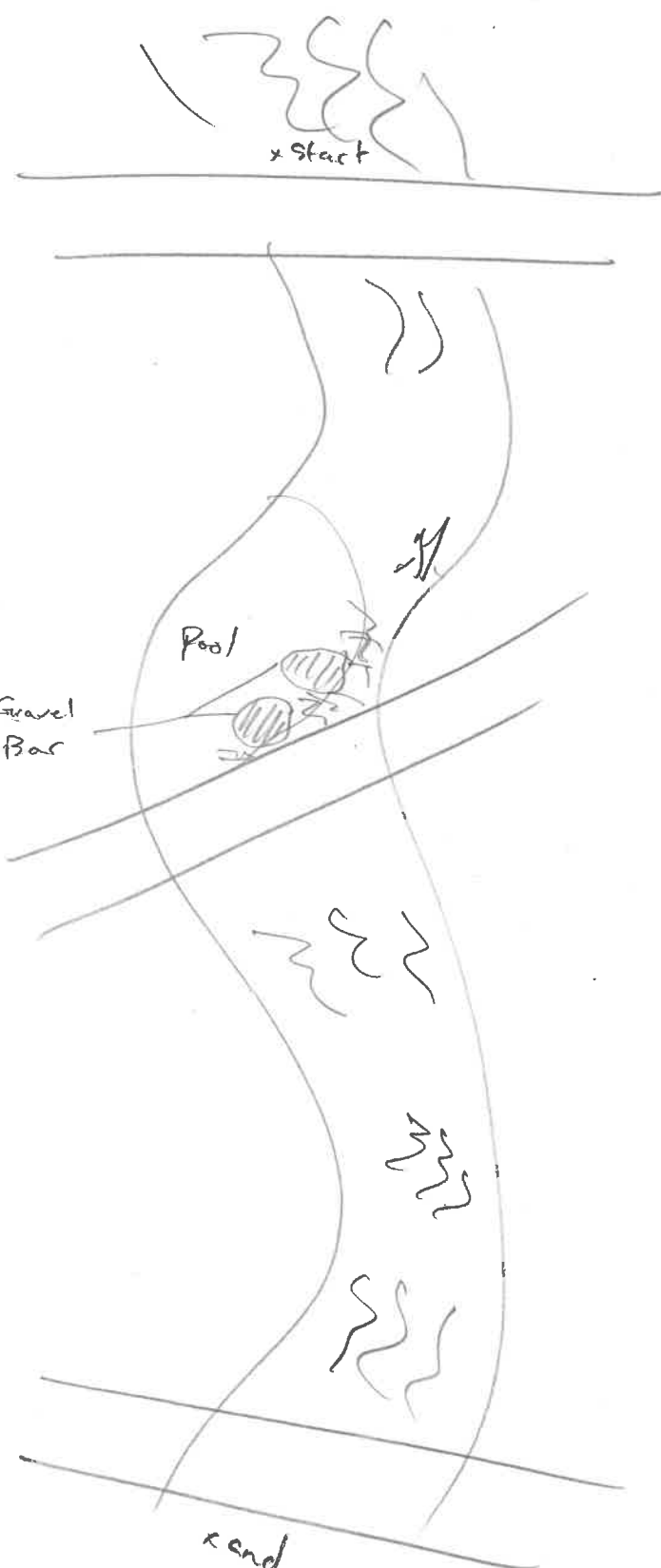
E) ISSUES

Circle some & COMMENT

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

- F) MEASUREMENTS**
- \bar{x} width
 - \bar{x} depth
 - max. depth
 - \bar{x} bankfull width
 - bankfull \bar{x} depth
 - W/D ratio
 - bankfull max. depth
 - floodprone \bar{x} width
 - entrench. ratio
- Legacy Tree:

C) RECREATION



Stream Drawing:

Stream & Location: Scioto River Dsl Olentangy River RM: 132.1 Date: 8/11/2022

Scorers Full Name & Affiliation: HBI-MAS Office verified location []

River Code: 02-00 STORET#: Lat./Long.: 39 18 3

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. BEST TYPES: BLDR/SLABS [10], BOULDER [9], COBBLE [8], GRAVEL [7], SAND [6], BEDROCK [5]. OTHER TYPES: HARDPAN [4], DETRITUS [3], MUCK [2], SILT [2], ARTIFICIAL [0]. ORIGIN: LIMESTONE [1], TILLS [1], WETLANDS [0], HARDPAN [0], SANDSTONE [0], RIP/RAP [0], LACUSTURINE [0], SHALE [-1], COAL FINES [-2]. QUALITY: HEAVY [-2], MODERATE [-1], NORMAL [0], FREE [1], EXTENSIVE [-2], MODERATE [-1], NORMAL [0], NONE [1].

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts; 2-Moderate amounts; 3-Highest quality. AMOUNT: EXTENSIVE >75% [11], MODERATE 25-75% [7], SPARSE 5-<25% [3], NEARLY ABSENT <5% [1].

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). SINUOSITY: HIGH [4], MODERATE [3], LOW [2], NONE [1]. DEVELOPMENT: EXCELLENT [7], GOOD [5], FAIR [3], POOR [1]. CHANNELIZATION: NONE [6], RECOVERED [4], RECOVERING [3], RECENT OR NO RECOVERY [1]. STABILITY: HIGH [3], MODERATE [2], LOW [1].

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). EROSION: NONE/LITTLE [3], MODERATE [2], HEAVY/SEVERE [1]. RIPARIAN WIDTH: WIDE > 50m [4], MODERATE 10-50m [3], NARROW 5-10m [2], VERY NARROW < 5m [1], NONE [0]. FLOOD PLAIN QUALITY: FOREST, SWAMP [3], SHRUB OR OLD FIELD [2], RESIDENTIAL, PARK, NEW FIELD [1], FENCED PASTURE [1], OPEN PASTURE, ROWCROP [0]. CONSERVATION TILLAGE [1], URBAN OR INDUSTRIAL [0], MINING / CONSTRUCTION [0].

5) POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH: > 1m [6], 0.7-1m [4], 0.4-0.7m [2], 0.2-0.4m [1], < 0.2m [0]. CHANNEL WIDTH: POOL WIDTH > RIFFLE WIDTH [2], POOL WIDTH = RIFFLE WIDTH [1], POOL WIDTH < RIFFLE WIDTH [0]. CURRENT VELOCITY: TORRENTIAL [-1], VERY FAST [1], FAST [1], MODERATE [1], SLOW [1], INTERSTITIAL [-1], INTERMITTENT [-2], EDDIES [1].

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: RIFFLE DEPTH: BEST AREAS > 10cm [2], BEST AREAS 5-10cm [1], BEST AREAS < 5cm [metric=0]. RUN DEPTH: MAXIMUM > 50cm [2], MAXIMUM < 50cm [1]. RIFFLE / RUN SUBSTRATE: STABLE (e.g., Cobble, Boulder) [2], MOD. STABLE (e.g., Large Gravel) [1], UNSTABLE (e.g., Fine Gravel, Sand) [0]. RIFFLE / RUN EMBEDDEDNESS: NONE [2], LOW [1], MODERATE [0], EXTENSIVE [-1].

6) GRADIENT (6.1 ft/mi) DRAINAGE AREA (1610 mi^2) VERY LOW - LOW [2-4], MODERATE [6-10], HIGH - VERY HIGH [10-6]. %POOL: 2 %GLIDE: 8 %RUN: 8 %RIFFLE: 8

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

1st-sample pass-- 2nd

CLARITY

- < 20 cm
- 20-<40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%- CLOSED

- _____ cm
- _____ cm

CJ RECREATION

- AREA >100ft²
- DEPTH >3ft

BJ AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

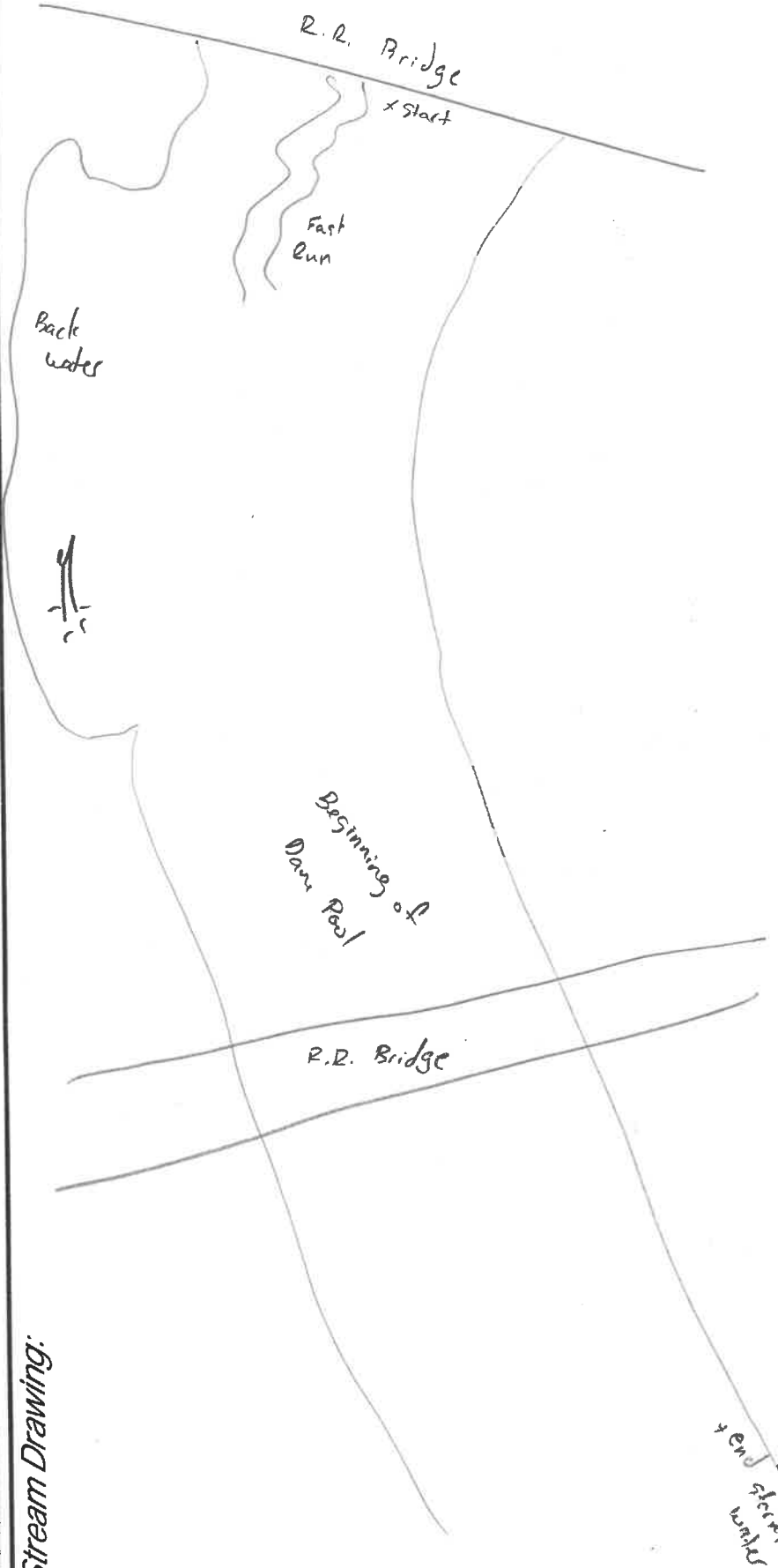
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Scioto River Ust Greenlawn Dam RM: 130.4 Date: 8/11/2022

9R05

Scorers Full Name & Affiliation: MAS - MBI

River Code: 02 - 001 - STORET #: Lat/Long: 39 183 Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Substrate assessment section with categories: BEST TYPES, OTHER TYPES, POOL RIFFLE, ORIGIN, and QUALITY. Includes checkboxes for various substrate types and a circled score of 14.

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts

Instream Cover assessment section with categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes checkboxes and a circled score of 15.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel Morphology assessment section with categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes checkboxes and a circled score of 6.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Bank Erosion and Riparian Zone assessment section with categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes checkboxes and a circled score of 5.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY

Pool / Glide and Riffle / Run Quality assessment section with categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY, Recreation Potential. Includes checkboxes and a circled score of 1.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Riffle assessment section with categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes checkboxes and a circled score of 0.

6) GRADIENT (6.5 ft/mi) DRAINAGE AREA (1620 mi^2) %POOL: %GLIDE: %RUN: %RIFFLE: Gradient Maximum 10. Includes a circled score of 10.

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

A) SAMPLED REACH
Check ALL that apply

- METHOD**
- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY
- CLARITY**
- 1st --sample pass-- 2nd
 - < 20 cm
 - 20-<40 cm
 - 40-70 cm
 - > 70 cm/ CTB
- DISTANCE**
- 0.5 Km
 - 0.2 Km
 - 0.15 Km
 - 0.12 Km
 - OTHER

- SECCCHI DEPTH**
- 1st _____ cm
 - 2nd _____ cm
- CANOPY**
- > 85% - OPEN
 - 55%-<85%
 - 30%-<55%
 - 10%-<30%
 - <10% - CLOSED

- B) AESTHETICS**
- NUISANCE ALGAE
 - INVASIVE MACROPHYTES
 - EXCESS TURBIDITY
 - DISCOLORATION
 - FOAM / SCUM
 - OIL SHEEN
 - TRASH / LITTER
 - NUISANCE ODOR
 - SLUDGE DEPOSITS
 - CSOs/SSOs/OUTFALLS
- C) RECREATION**
- AREA DEPTH
- POOL: >100ft² >3ft

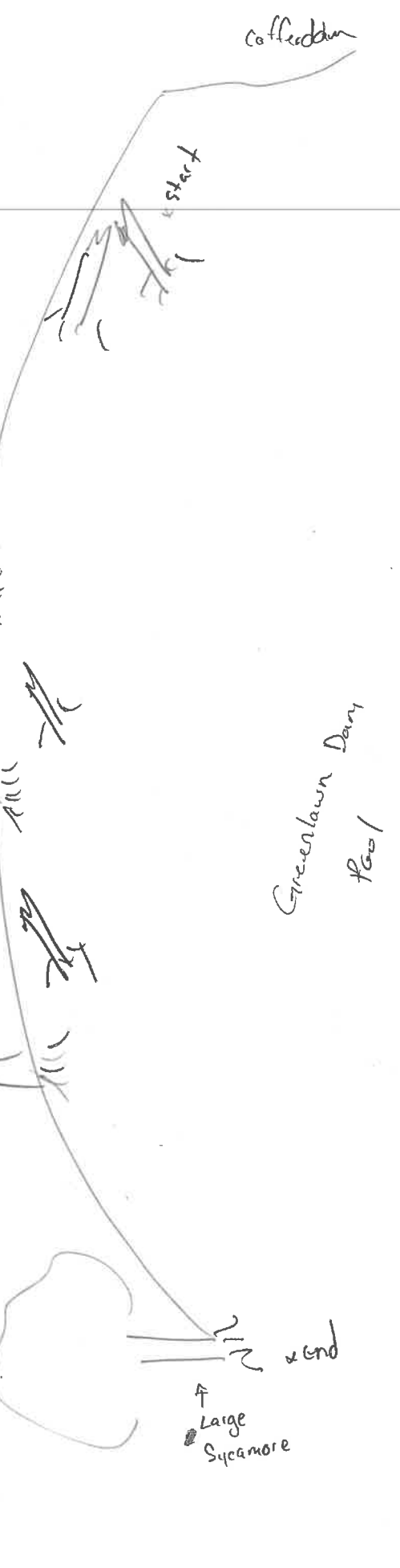
- D) MAINTENANCE**
- PUBLIC / PRIVATE / BOTH / NA
 - ACTIVE / HISTORIC / BOTH / NA
 - YOUNG-SUCCESSION-OLD
 - SPRAY / SNAG / REMOVED
 - MODIFIED / DIPPED OUT / NA
 - LEVEED / ONE SIDED
 - RELOCATED / CUTOFFS
 - MOVING-BEDLOAD-STABLE
 - ARMoured / SLUMPS
 - ISLANDS / SCoured
 - IMPOUNDED / DESICCATED
 - FLOOD CONTROL / DRAINAGE

Circle some & COMMENT

- E) ISSUES**
- WWTP / CSO / NPDES / INDUSTRY
 - HARDENED / URBAN / DIRT&GRIME
 - CONTAMINATED / LANDFILL
 - BMPs-CONSTRUCTION-SEDIMENT
 - LOGGING / IRRIGATION / COOLING
 - BANK / EROSION / SURFACE
 - FALSE BANK / MANURE / LAGOON
 - WASH H₂O / TILE / H₂O TABLE
 - ACID / MINE / QUARRY / FLOW
 - NATURAL / WETLAND / STAGNANT
 - PARK / GOLF / LAWN / HOME
 - ATMOSPHERE / DATA PAUCITY

- F) MEASUREMENTS**
- \bar{x} width
 - \bar{x} depth
 - max. depth
 - \bar{x} bankfull width
 - bankfull \bar{x} depth
 - W/D ratio
 - bankfull max. depth
 - floodprone \bar{x}^2 width
 - entrench. ratio
- Legacy Tree:

Stream Drawing:



Stream & Location: Saco River dst. Greenlawn Ave. RM: 129.4 Date: 8/18/2022

SRO6
 River Code: 02-001- STORET #: _____ Lat./Long.: 39.93849 182.99965 Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES		OTHER TYPES		ORIGIN		QUALITY	
<input type="checkbox"/> BLDR /SLABS [10]	<input type="checkbox"/> POOL RIFFLE	<input type="checkbox"/> HARDPAN [4]	<input type="checkbox"/> POOL RIFFLE	<input type="checkbox"/> LIMESTONE [1]	<input type="checkbox"/> SILT	<input type="checkbox"/> HEAVY [-2]	Substrate
<input type="checkbox"/> BOULDER [9]	<input checked="" type="checkbox"/> α <input checked="" type="checkbox"/> α	<input type="checkbox"/> DETRITUS [3]	<input checked="" type="checkbox"/> α	<input checked="" type="checkbox"/> TILLS [1]	<input type="checkbox"/> WETLANDS [0]	<input type="checkbox"/> MODERATE [-1]	
<input type="checkbox"/> COBBLE [8]	<input checked="" type="checkbox"/> α <input checked="" type="checkbox"/> α	<input type="checkbox"/> MUCK [2]	<input checked="" type="checkbox"/> α	<input type="checkbox"/> HARDPAN [0]	<input type="checkbox"/> SANDSTONE [0]	<input type="checkbox"/> NORMAL [0]	Maximum 20
<input checked="" type="checkbox"/> GRAVEL [7]	<input checked="" type="checkbox"/> α <input checked="" type="checkbox"/> α	<input type="checkbox"/> SILT [2]	<input checked="" type="checkbox"/> α	<input type="checkbox"/> RIP/RAP [0]	<input type="checkbox"/> LACUSTURINE [0]	<input checked="" type="checkbox"/> FREE [1]	
<input checked="" type="checkbox"/> SAND [6]	<input checked="" type="checkbox"/> α	<input type="checkbox"/> ARTIFICIAL [0]		<input type="checkbox"/> SHALE [-1]	<input type="checkbox"/> COAL FINES [-2]	<input type="checkbox"/> EXTENSIVE [-2]	EMBEDDEDNESS
<input type="checkbox"/> BEDROCK [5]				<input type="checkbox"/> NONE [1]		<input type="checkbox"/> MODERATE [-1]	

NUMBER OF BEST TYPES: 4 or more [2] sludge from point-sources) 3 or less [0]

Comments _____

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

<u>0</u> UNDERCUT BANKS [1]	<u>3</u> POOLS > 70cm [2]	<u>2</u> OXBOWS, BACKWATERS [1]	Check ONE (Or 2 & average)
<u>1</u> OVERHANGING VEGETATION [1]	<u>1</u> ROOTWADS [1]	<u>2</u> AQUATIC MACROPHYTES [1]	
<u>3</u> SHALLOWS (IN SLOW WATER) [1]	<u>2</u> BOULDERS [1]	<u>2</u> LOGS OR WOODY DEBRIS [1]	
<u>2</u> ROOTMATS [1]			

AMOUNT: EXTENSIVE >75% [11] MODERATE 25-75% [7] SPARSE 5-<25% [3] NEARLY ABSENT <5% [1]

Comments _____

Cover Maximum 20 17

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
<input type="checkbox"/> HIGH [4]	<input checked="" type="checkbox"/> EXCELLENT [7]	<input checked="" type="checkbox"/> NONE [6]	<input checked="" type="checkbox"/> HIGH [3]
<input checked="" type="checkbox"/> MODERATE [3]	<input checked="" type="checkbox"/> GOOD [5]	<input type="checkbox"/> RECOVERED [4]	<input checked="" type="checkbox"/> MODERATE [2]
<input type="checkbox"/> LOW [2]	<input type="checkbox"/> FAIR [3]	<input type="checkbox"/> RECOVERING [3]	<input type="checkbox"/> LOW [1]
<input type="checkbox"/> NONE [1]	<input type="checkbox"/> POOR [1]	<input type="checkbox"/> RECENT OR NO RECOVERY [1]	

Comments _____

Channel Maximum 20 17.5

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

EROSION	RIPARIAN WIDTH	FLOOD PLAIN QUALITY
<input checked="" type="checkbox"/> NONE / LITTLE [3]	<input type="checkbox"/> WIDE > 50m [4]	<input type="checkbox"/> FOREST, SWAMP [3]
<input type="checkbox"/> MODERATE [2]	<input checked="" type="checkbox"/> MODERATE 10-50m [3]	<input type="checkbox"/> SHRUB OR OLD FIELD [2]
<input type="checkbox"/> HEAVY / SEVERE [1]	<input checked="" type="checkbox"/> NARROW 5-10m [2]	<input checked="" type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1]
	<input type="checkbox"/> VERY NARROW < 5m [1]	<input type="checkbox"/> FENCED PASTURE [1]
	<input type="checkbox"/> NONE [0]	<input type="checkbox"/> OPEN PASTURE, ROWCROP [0]

Indicate predominant land use(s) past 100m riparian.

Comments _____

Riparian Maximum 10 5.5

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH Check ONE (ONLY!)	CHANNEL WIDTH Check ONE (Or 2 & average)	CURRENT VELOCITY Check ALL that apply	Recreation Potential Primary Contact Secondary Contact (circle one and comment on back)
<input checked="" type="checkbox"/> > 1m [6]	<input checked="" type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2]	<input type="checkbox"/> TORRENTIAL [-1]	
<input type="checkbox"/> 0.7-1m [4]	<input type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1]	<input checked="" type="checkbox"/> SLOW [1]	Pool / Current Maximum 12
<input type="checkbox"/> 0.4-0.7m [2]	<input checked="" type="checkbox"/> POOL WIDTH < RIFFLE WIDTH [0]	<input type="checkbox"/> VERY FAST [1]	
<input type="checkbox"/> 0.2-0.4m [1]		<input type="checkbox"/> INTERSTITIAL [-1]	Indicate for reach - pools and riffles.
<input type="checkbox"/> < 0.2m [0]		<input checked="" type="checkbox"/> FAST [1]	
		<input checked="" type="checkbox"/> MODERATE [1]	
		<input checked="" type="checkbox"/> EDDIES [1]	

Comments _____

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
<input checked="" type="checkbox"/> BEST AREAS > 10cm [2]	<input checked="" type="checkbox"/> MAXIMUM > 50cm [2]	<input checked="" type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2]	<input checked="" type="checkbox"/> NONE [2]
<input checked="" type="checkbox"/> BEST AREAS 5-10cm [1]	<input type="checkbox"/> MAXIMUM < 50cm [1]	<input type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1]	<input type="checkbox"/> LOW [1]
<input type="checkbox"/> BEST AREAS < 5cm [metric=0]		<input type="checkbox"/> UNSTABLE (e.g., Fine Gravel, Sand) [0]	<input type="checkbox"/> MODERATE [0]
			<input type="checkbox"/> EXTENSIVE [-1]

Comments _____

Riffle / Run Maximum 8 8

6] GRADIENT (1.8 ft/mi) VERY LOW - LOW [2-4] MODERATE [6-10] HIGH - VERY HIGH [10-6]

DRAINAGE AREA (1620 mi²)

% POOL: % GLIDE:
 % RUN: % RIFFLE:

Comments _____

Gradient Maximum 10 10

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH
Check ALL that apply

- METHOD**
- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

- DISTANCE**
- 0.5 Km
 - 0.2 Km
 - 0.15 Km
 - 0.12 Km
 - OTHER
- CLARITY**
- 1st --sample pass-- 2nd
 - < 20 cm
 - 20-40 cm
 - 40-70 cm
 - > 70 cm/ CTB
 - SECCHI DEPTH

- CANOPY**
- > 85% - OPEN
 - 55% - < 85%
 - 30% - < 55%
 - 10% - < 30%
 - < 10% - CLOSED

- B/AESTHETICS**
- NUISANCE ALGAE
 - INVASIVE MACROPHYTES
 - EXCESS TURBIDITY
 - DISCOLORATION
 - FOAM / SCUM
 - OIL SHEEN
 - TRASH / LITTER
 - NUISANCE ODOR
 - SLUDGE DEPOSITS
 - CSOs/SOs/OUTFALLS
- C/RECREATION** AREA DEPTH
- POOL: >100ft² >3ft

- D/J MAINTENANCE**
- PUBLIC / PRIVATE / BOTH / NA
 - ACTIVE / HISTORIC / BOTH / NA
 - YOUNG-SUCCESSION-OLD
 - SPRAY / SNAG / REMOVED
 - MODIFIED / DIPPED OUT / NA
 - LEVEED / ONE SIDED
 - RELOCATED / CUTOFFS
 - MOVING-BEDLOAD-STABLE
 - ARMoured / SLUMPS
 - ISLANDS / SCOURED
 - IMPOUNDED / DESICCATED
 - FLOOD CONTROL / DRAINAGE

Circle some & COMMENT

- E/I ISSUES**
- WWTP / CSO / NPDES / INDUSTRY
 - HARDENED / URBAN / DIRT & GRIME
 - CONTAMINATED / LANDFILL
 - BMPs-CONSTRUCTION-SEDIMENT
 - LOGGING / IRRIGATION / COOLING
 - BANK / EROSION / SURFACE
 - FALSE BANK / MANURE / LAGOON
 - WASH H₂O / TILE / H₂O TABLE
 - ACID / MINE / QUARRY / FLOW
 - NATURAL / WETLAND / STAGNANT
 - PARK / GOLF / LAWN / HOME
 - ATMOSPHERE / DATA PAUCITY

- F/J MEASUREMENTS**
- \bar{x} width
 - \bar{x} depth
 - max. depth
 - \bar{x} bankfull width
 - bankfull \bar{x} depth
 - W/D ratio
 - bankfull max. depth
 - floodprone \bar{x}^2 width
 - entrench. ratio
- Legacy Tree:

Stream Drawing:



Stream & Location: Scioto River Dist 5 + Rt 104 RM: 127.7 Date: 8/18/2022

SR07 Scorers Full Name & Affiliation: MBI - MAS

River Code: 02 - 001 - STORET #: Lat./Long: 39.91684 183.00939 Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. Includes categories: BEST TYPES, OTHER TYPES, POOL RIFFLE, ORIGIN, and QUALITY. Includes a 'Substrate' score box with value 16.

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts... Includes categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes an 'Amount' score box with value 16.

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). Includes categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes a 'Channel' score box with value 17.5.

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). Includes categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes a 'Riparian' score box with value 10.

5] POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY. Includes a 'Recreation Potential' box and a 'Pool / Current' score box with value 12.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species. Includes categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes a 'Riffle / Run' score box with value 8.

6] GRADIENT (1.8 ft/ml) DRAINAGE AREA (11620 mi^2). Includes categories: GRADIENT, DRAINAGE AREA, % POOL, % GLIDE, % RUN, % RIFFLE. Includes a 'Gradient' score box with value 10.

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

A) SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

meters

CANOPY

- > 85% - OPEN
- 55% - < 85%
- 30% - < 55%
- 10% - < 30%
- < 10% - CLOSED

B) AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOS/SSOs/OUTFALLS

C) RECREATION

- AREA DEPTH
- POOL: > 100ft? > 3ft

D) MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

Circle some & COMMENT

E) ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

F) MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Scioto River Ust Jackson Pike WcSTP RM: 127.4 Date: 8/18/2022

Slor.2 Scorers Full Name & Affiliation: MAS - MBI
 River Code: 02 - 001 - STORET #: Lat./Long.: 39 183 Office verified location

1] **SUBSTRATE** Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

<p>BEST TYPES</p> <input type="checkbox"/> BLDR /SLABS [10] <input type="checkbox"/> BOULDER [9] <input type="checkbox"/> COBBLE [8] <input checked="" type="checkbox"/> GRAVEL [7] <input checked="" type="checkbox"/> SAND [6] <input type="checkbox"/> BEDROCK [5]	<p>POOL RIFFLE</p> <p><u>K</u> <u> </u> <u>K</u> <u> </u> <u>X</u> <u> </u> <u>X</u> <u> </u></p>	<p>OTHER TYPES</p> <input type="checkbox"/> HARDPAN [4] <input type="checkbox"/> DETRITUS [3] <input type="checkbox"/> MUCK [2] <input type="checkbox"/> SILT [2] <input type="checkbox"/> ARTIFICIAL [0]	<p>POOL RIFFLE</p> <p><u>K</u> <u> </u> <u> </u> <u> </u> <u> </u> <u> </u></p>	<p>ORIGIN</p> <input type="checkbox"/> LIMESTONE [1] <input checked="" type="checkbox"/> TILLS [1] <input type="checkbox"/> WETLANDS [0] <input type="checkbox"/> HARDPAN [0] <input type="checkbox"/> SANDSTONE [0] <input type="checkbox"/> RIP/RAP [0] <input type="checkbox"/> LACUSTURINE [0] <input type="checkbox"/> SHALE [-1] <input type="checkbox"/> COAL FINES [-2]	<p>QUALITY</p> <input type="checkbox"/> HEAVY [-2] <input checked="" type="checkbox"/> MODERATE [-1] <input type="checkbox"/> NORMAL [0] <input type="checkbox"/> FREE [1] <input type="checkbox"/> EXTENSIVE [-2] <input checked="" type="checkbox"/> MODERATE [-1] <input type="checkbox"/> NORMAL [0] <input type="checkbox"/> NONE [1]
---	---	--	---	--	--

Check ONE (Or 2 & average)

NUMBER OF BEST TYPES: 4 or more [2] 3 or less [0] (Score natural substrates; ignore sludge from point-sources)

Comments:

14

Substrate Maximum 20

2] **INSTREAM COVER** Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

<p><u>0</u> UNDERCUT BANKS [1] <u>1</u> OVERHANGING VEGETATION [1] <u>3</u> SHALLOWS (IN SLOW WATER) [1] <u>2</u> ROOTMATS [1]</p>	<p><u>3</u> POOLS > 70cm [2] <u>2</u> ROOTWADS [1] <u>2</u> BOULDERS [1]</p>	<p><u>1</u> OXBOWS, BACKWATERS [1] <u>1</u> AQUATIC MACROPHYTES [1] <u>2</u> LOGS OR WOODY DEBRIS [1]</p>
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Check ONE (Or 2 & average)

AMOUNT

 EXTENSIVE >75% [11]
 MODERATE 25-75% [7]
 SPARSE 5-<25% [3]
 NEARLY ABSENT <5% [1]

Comments:

15

Cover Maximum 20

3] **CHANNEL MORPHOLOGY** Check ONE in each category (Or 2 & average)

<p>SINUOSITY</p> <input type="checkbox"/> HIGH [4] <input type="checkbox"/> MODERATE [3] <input checked="" type="checkbox"/> LOW [2] <input type="checkbox"/> NONE [1]	<p>DEVELOPMENT</p> <input type="checkbox"/> EXCELLENT [7] <input type="checkbox"/> GOOD [5] <input type="checkbox"/> FAIR [3] <input checked="" type="checkbox"/> POOR [1]	<p>CHANNELIZATION</p> <input checked="" type="checkbox"/> NONE [6] <input type="checkbox"/> RECOVERED [4] <input type="checkbox"/> RECOVERING [3] <input type="checkbox"/> RECENT OR NO RECOVERY [1]	<p>STABILITY</p> <input type="checkbox"/> HIGH [3] <input checked="" type="checkbox"/> MODERATE [2] <input type="checkbox"/> LOW [1]
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Comments:

11

Channel Maximum 20

4] **BANK EROSION AND RIPARIAN ZONE** Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

<p>EROSION</p> <input checked="" type="checkbox"/> NONE / LITTLE [3] <input type="checkbox"/> MODERATE [2] <input type="checkbox"/> HEAVY / SEVERE [1]	<p>RIPARIAN WIDTH</p> <input type="checkbox"/> WIDE > 50m [4] <input type="checkbox"/> MODERATE 10-50m [3] <input checked="" type="checkbox"/> NARROW 5-10m [2] <input type="checkbox"/> VERY NARROW < 5m [1] <input type="checkbox"/> NONE [0]	<p>FLOOD PLAIN QUALITY</p> <input type="checkbox"/> FOREST, SWAMP [3] <input type="checkbox"/> SHRUB OR OLD FIELD [2] <input type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1] <input type="checkbox"/> FENCED PASTURE [1] <input type="checkbox"/> OPEN PASTURE, ROWCROP [0]	<p>CONSERVATION TILLAGE [1] <input checked="" type="checkbox"/> URBAN OR INDUSTRIAL [0] <input type="checkbox"/> MINING / CONSTRUCTION [0]</p>
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Indicate predominant land use(s) past 100m riparian.

Comments:

5

Riparian Maximum 10

5] **POOL / GLIDE AND RIFFLE / RUN QUALITY**

<p>MAXIMUM DEPTH Check ONE (ONLY!)</p> <input checked="" type="checkbox"/> > 1m [6] <input type="checkbox"/> 0.7-1m [4] <input type="checkbox"/> 0.4-0.7m [2] <input type="checkbox"/> 0.2-0.4m [1] <input type="checkbox"/> < 0.2m [0]	<p>CHANNEL WIDTH Check ONE (Or 2 & average)</p> <input type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2] <input type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1] <input checked="" type="checkbox"/> POOL WIDTH < RIFFLE WIDTH [0]	<p>CURRENT VELOCITY Check ALL that apply</p> <input type="checkbox"/> TORRENTIAL [-1] <input type="checkbox"/> VERY FAST [1] <input type="checkbox"/> FAST [1] <input type="checkbox"/> MODERATE [1] <input checked="" type="checkbox"/> SLOW [1] <input type="checkbox"/> INTERSTITIAL [-1] <input type="checkbox"/> INTERMITTENT [-2] <input type="checkbox"/> EDDIES [1]
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Indicate for reach - pools and riffles.

Recreation Potential

Primary Contact

Secondary Contact

(circle one and comment on back)

Comments:

7

Pool / Current Maximum 12

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

<p>RIFFLE DEPTH</p> <input type="checkbox"/> BEST AREAS > 10cm [2] <input type="checkbox"/> BEST AREAS 5-10cm [1] <input checked="" type="checkbox"/> BEST AREAS < 5cm [metric=0]	<p>RUN DEPTH</p> <input type="checkbox"/> MAXIMUM > 50cm [2] <input type="checkbox"/> MAXIMUM < 50cm [1]	<p>RIFFLE / RUN SUBSTRATE</p> <input type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2] <input type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1] <input type="checkbox"/> UNSTABLE (e.g., Fine Gravel, Sand) [0]	<p>RIFFLE / RUN EMBEDDEDNESS</p> <input type="checkbox"/> NONE [2] <input type="checkbox"/> LOW [1] <input type="checkbox"/> MODERATE [0] <input type="checkbox"/> EXTENSIVE [-1]
--	--	--	---

Check ONE (Or 2 & average). NO RIFFLE [metric=0]

Comments:

0

Riffle / Run Maximum 8

6] **GRADIENT** (1.8 ft/mi) VERY LOW - LOW [2-4] MODERATE [6-10] HIGH - VERY HIGH [10-6]

DRAINAGE AREA (1620 mi²)

%POOL: %GLIDE:
 %RUN: %RIFFLE:

Comments:

10

Gradient Maximum 10

Stream & Location: Scioto River Dst Jackson Pike WWTP RM: 126.55 Date: 8/31/2022

River Code: 02 - 001 STORET #: Lat./Long.: 39.90166 183.00355 Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. Includes categories: BEST TYPES, OTHER TYPES, POOL RIFFLE, ORIGIN, and QUALITY. Includes a 'Substrate' box with value 18 and 'Maximum 20'.

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts... Includes categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes an 'Amount' box with value 17 and 'Maximum 20'.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). Includes categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes a 'Channel' box with value 17.5 and 'Maximum 20'.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). Includes categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes a 'Riparian' box with value 4.5 and 'Maximum 10'.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY Includes categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY. Includes a 'Recreation Potential' box with value 11 and 'Maximum 12'.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species. Includes categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes a 'Riffle / Run' box with value 7 and 'Maximum 8'.

6) GRADIENT (1.8 ft/mi) DRAINAGE AREA (11630 mi^2). Includes categories: GRADIENT, DRAINAGE AREA, %POOL, %GLIDE, %RUN, %RIFFLE. Includes a 'Gradient' box with value 10 and 'Maximum 10'.

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

A) SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st sample pass-- 2nd
- < 20 cm
 - 20-40 cm
 - 40-70 cm
 - > 70 cm/ CTB
 - SECCHI DEPTH

meters

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%- CLOSED

C) RECREATION

AREA DEPTH
POOL: >100ft? >3ft.

B) AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

D) MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

Circle some & COMMENT

E) ISSUES

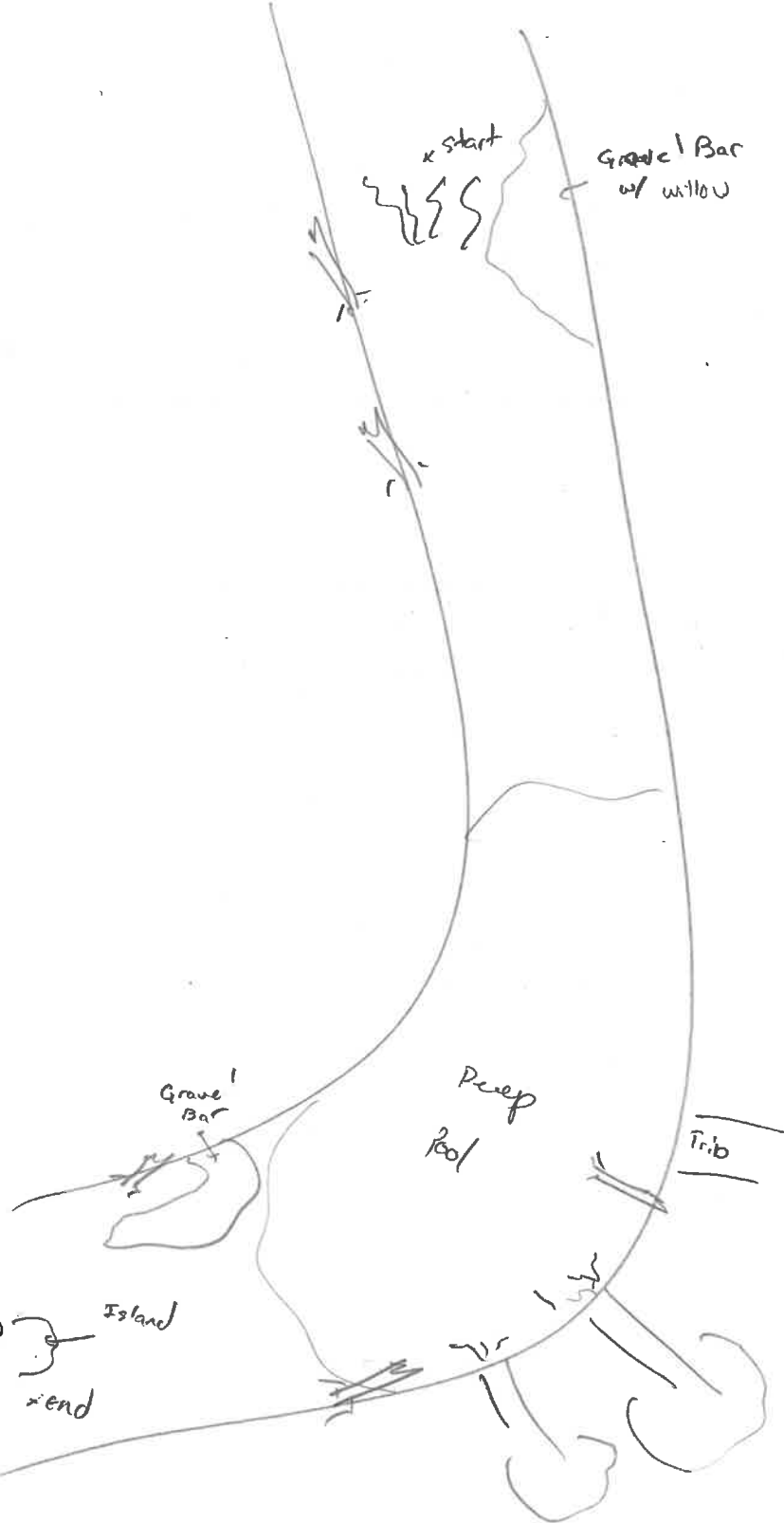
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

F) MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Scioto River Dst American Aggregates RM: 125.2 Date: 8/31/2022

SR09 Scorers Full Name & Affiliation: MBI-MAS
 River Code: 02-001 - STORET #: _____ Lat./Long.: 39 183 Office verified location

1] **SUBSTRATE** Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES		POOL RIFFLE	OTHER TYPES		POOL RIFFLE	ORIGIN	QUALITY
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Check ONE (Or 2 & average)

NUMBER OF BEST TYPES: 4 or more [2] 3 or less [0]

Comments _____

Substrate
14
 Maximum 20

2] **INSTREAM COVER** Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

<u>0</u> UNDERCUT BANKS [1]	<u>3</u> POOLS > 70cm [2]	<u>0</u> OXBOWS, BACKWATERS [1]	Check ONE (Or 2 & average)
<u>2</u> OVERHANGING VEGETATION [1]	<u>2</u> ROOTWADS [1]	<u>0</u> AQUATIC MACROPHYTES [1]	<input type="checkbox"/> EXTENSIVE >75% [11]
<u>1</u> SHALLOWS (IN SLOW WATER) [1]	<u>1</u> BOULDERS [1]	<u>3</u> LOGS OR WOODY DEBRIS [1]	<input type="checkbox"/> MODERATE 25-75% [7]
<u>2</u> ROOTMATS [1]			<input type="checkbox"/> SPARSE 5-<25% [3]
			<input type="checkbox"/> NEARLY ABSENT <5% [1]

Comments _____

Cover
 Maximum 20
15

3] **CHANNEL MORPHOLOGY** Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
<input type="checkbox"/> HIGH [4]	<input type="checkbox"/> EXCELLENT [7]	<input checked="" type="checkbox"/> NONE [6]	<input type="checkbox"/> HIGH [3]
<input type="checkbox"/> MODERATE [3]	<input type="checkbox"/> GOOD [5]	<input type="checkbox"/> RECOVERED [4]	<input checked="" type="checkbox"/> MODERATE [2]
<input checked="" type="checkbox"/> LOW [2]	<input type="checkbox"/> FAIR [3]	<input type="checkbox"/> RECOVERING [3]	<input type="checkbox"/> LOW [1]
<input type="checkbox"/> NONE [1]	<input checked="" type="checkbox"/> POOR [1]	<input type="checkbox"/> RECENT OR NO RECOVERY [1]	

Comments _____

Channel
 Maximum 20
11

4] **BANK EROSION AND RIPARIAN ZONE** Check ONE in each category for EACH BANK (Or 2 per bank & average)

EROSION	RIPARIAN WIDTH	FLOOD PLAIN QUALITY
<input checked="" type="checkbox"/> NONE / LITTLE [3]	<input type="checkbox"/> WIDE > 50m [4]	<input type="checkbox"/> FOREST, SWAMP [3]
<input checked="" type="checkbox"/> MODERATE [2]	<input type="checkbox"/> MODERATE 10-50m [3]	<input type="checkbox"/> SHRUB OR OLD FIELD [2]
<input type="checkbox"/> HEAVY / SEVERE [1]	<input checked="" type="checkbox"/> NARROW 5-10m [2]	<input type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1]
	<input type="checkbox"/> VERY NARROW < 5m [1]	<input type="checkbox"/> FENCED PASTURE [1]
	<input type="checkbox"/> NONE [0]	<input type="checkbox"/> OPEN PASTURE, ROWCROP [0]

Indicate predominant land use(s) past 100m riparian.

Comments _____

Riparian
 Maximum 10
4.5

5] **POOL / GLIDE AND RIFFLE / RUN QUALITY**

MAXIMUM DEPTH	CHANNEL WIDTH	CURRENT VELOCITY	Recreation Potential Primary Contact Secondary Contact <small>(circle one and comment on back)</small>
Check ONE (ONLY!)	Check ONE (Or 2 & average)	Check ALL that apply	
<input checked="" type="checkbox"/> > 1m [6]	<input type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2]	<input type="checkbox"/> TORRENTIAL [-1]	
<input type="checkbox"/> 0.7-<1m [4]	<input type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1]	<input checked="" type="checkbox"/> SLOW [1]	

Indicate for reach - pools and riffles.

Comments _____

Pool / Current
 Maximum 12
7

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
<input type="checkbox"/> BEST AREAS > 10cm [2]	<input type="checkbox"/> MAXIMUM > 50cm [2]	<input type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2]	<input type="checkbox"/> NONE [2]
<input type="checkbox"/> BEST AREAS 5-10cm [1]	<input type="checkbox"/> MAXIMUM < 50cm [1]	<input type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1]	<input type="checkbox"/> LOW [1]
<input checked="" type="checkbox"/> BEST AREAS < 5cm [metric=0]		<input type="checkbox"/> UNSTABLE (e.g., Fine Gravel, Sand) [0]	<input type="checkbox"/> MODERATE [0]
			<input type="checkbox"/> EXTENSIVE [-1]

Comments _____

Riffle / Run
 Maximum 8
0

6] **GRADIENT** (1.8 ft/mi) VERY LOW - LOW [2-4] MODERATE [6-10] HIGH - VERY HIGH [10-6]

DRAINAGE AREA (1640 mi²)

%POOL: 2 %GLIDE: 8

%RUN: 8 %RIFFLE: 8

Comments _____

Gradient
 Maximum 10
10

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH
Check ALL that apply

- METHOD**
- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY
- DISTANCE**
- 0.5 Km
 - 0.2 Km
 - 0.15 Km
 - 0.12 Km
 - OTHER

- CLARITY**
- 1st sample pass-- 2nd
- < 20 cm
 - 20-40 cm
 - 40-70 cm
 - > 70 cm/ CTB
- SECCHI DEPTH**
- 1st _____ cm
- 2nd _____ cm
- CANOPY**
- > 85% - OPEN
 - 55% - < 85%
 - 30% - < 55%
 - 10% - < 30%
 - < 10% - CLOSED

- BJ AESTHETICS**
- NUISANCE ALGAE
 - INVASIVE MACROPHYTES
 - EXCESS TURBIDITY
 - DISCOLORATION
 - FOAM / SCUM
 - OIL SHEEN
 - TRASH / LITTER
 - NUISANCE ODOR
 - SLUDGE DEPOSITS
 - CSOs/SSOs/OUTFALLS
- CJ RECREATION** AREA DEPTH
- POOL: >100ft >3ft

- DJ MAINTENANCE**
- PUBLIC / PRIVATE / BOTH / NA
 - ACTIVE / HISTORIC / BOTH / NA
 - YOUNG-SUCCESSION-OLD
 - SPRAY / SNAG / REMOVED
 - MODIFIED / DIPPED OUT / NA
 - LEVEED / ONE SIDED
 - RELOCATED / CUTOFFS
 - MOVING-BEDLOAD-STABLE
 - ARMORED / SLUMPS
 - ISLANDS / SCOURED
 - IMPOUNDED / DESICCATED
 - FLOOD CONTROL / DRAINAGE

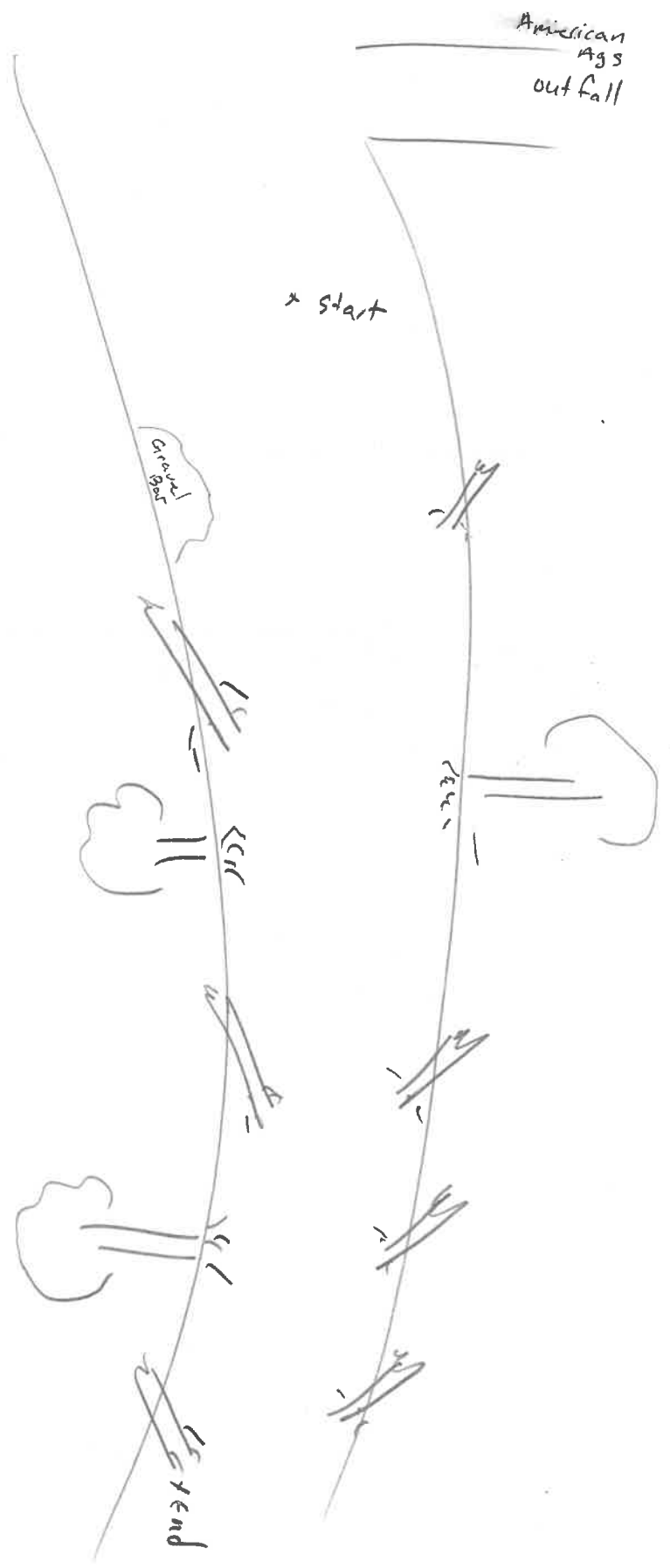
EJ ISSUES

Circle some & COMMENT

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT & GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

- FJ MEASUREMENTS**
- \bar{x} width
 - \bar{x} depth
 - max. depth
 - \bar{x} bankfull width
 - bankfull \bar{x} depth
 - W/D ratio
 - bankfull max. depth
 - floodprone \bar{x} width
 - entrench. ratio
- Legacy Tree:

Stream Drawing:



Stream & Location: Scioto Rver Dist I-270 RM: 124.4 Date: 8/31/2022

SRIU Scorers Full Name & Affiliation: MBI - MAS Office verified location

River Code: 02-001 STORET#: Lat./Long.: 39.87980 183.01849

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. Includes categories: BEST TYPES, OTHER TYPES, POOL RIFFLE, ORIGIN, and QUALITY. Includes a 'Substrate' box with value 16.

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts... Includes categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes a 'Cover' box with value 17.

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). Includes categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes a 'Channel' box with value 16.5.

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). Includes categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY, CONSERVATION TILLAGE, URBAN OR INDUSTRIAL, MINING / CONSTRUCTION. Includes a 'Riparian' box with value 4.25.

5] POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY. Includes a 'Recreation Potential' box with 'Primary Contact' and 'Secondary Contact' options. Includes a 'Pool / Current' box with value 11.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes a 'Riffle / Run' box with value 6.5.

6] GRADIENT (1.8 ft/ml) DRAINAGE AREA (1670 mi^2). Includes categories: VERY LOW - LOW, MODERATE, HIGH - VERY HIGH. Includes a 'Gradient' box with value 10.

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

A) SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

1st --sample pass-- 2nd

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/ CTB

meters

CANOPY

- > 85% - OPEN
- 55% - 85%
- 30% - 55%
- 10% - 30%
- < 10% - CLOSED

C) RECREATION

AREA DEPTH POOL: >100r2 >3ft

B) AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

D) MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

E) ISSUES

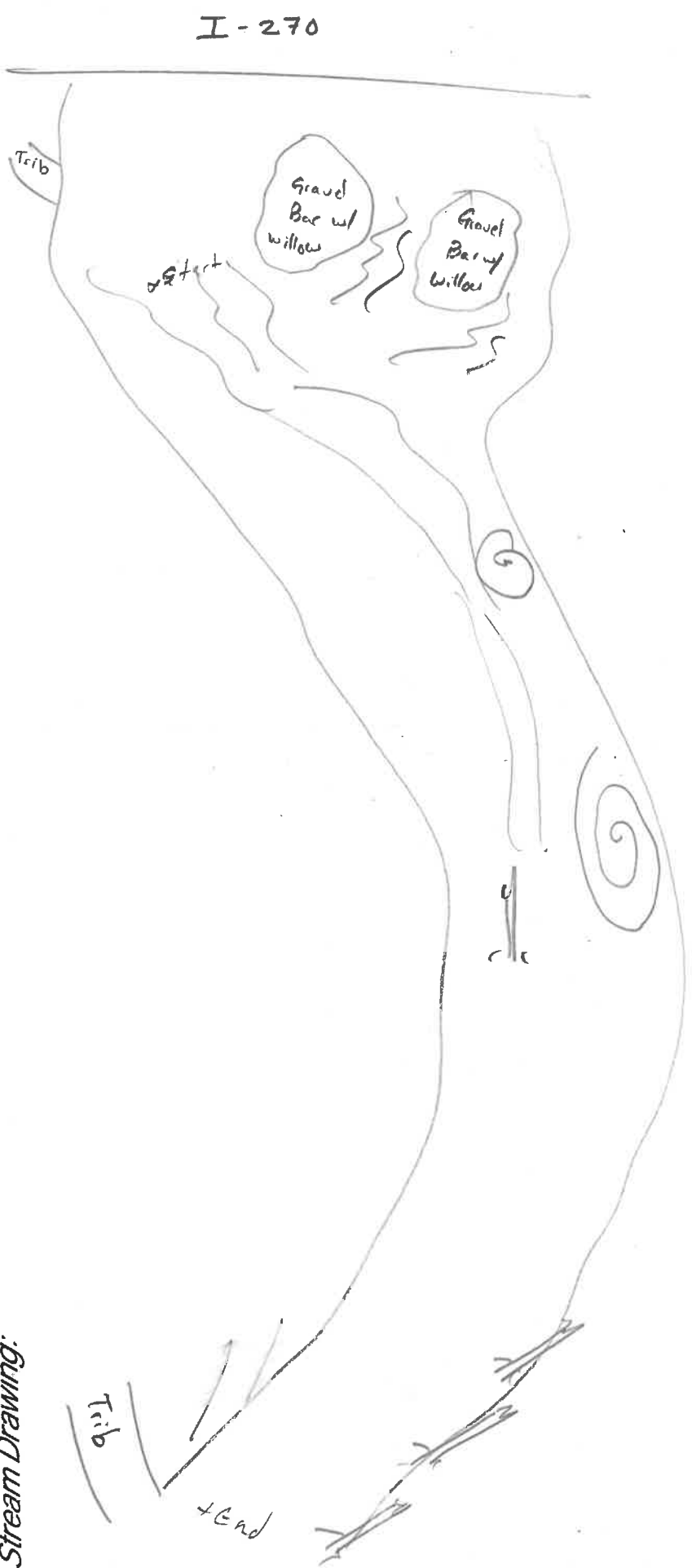
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT & GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

F) MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Scioto River @ 665 SR11

RM: 120.1 Date: 8/10/8/2022

River Code: 02-001 STORET#:

Scorers Full Name & Affiliation: MBI-MAS

Lat./Long.: 39.87378 183.00897

Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Check ONE (Or 2 & average)

Substrate assessment table with categories: BEST TYPES, OTHER TYPES, POOL RIFFLE, ORIGIN, QUALITY. Includes checkboxes for BLDR/SLABS, BOULDER, COBBLE, GRAVEL, SAND, BEDROCK, etc.

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts

AMOUNT Check ONE (Or 2 & average)

Instream Cover assessment table with categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel Morphology assessment table with categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes checkboxes for HIGH, MODERATE, LOW, NONE.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Bank Erosion and Riparian Zone assessment table with categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY, CONSERVATION TILLAGE, URBAN OR INDUSTRIAL, MINING / CONSTRUCTION.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY

Pool / Glide and Riffle / Run Quality assessment table with categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY, Recreation Potential. Includes checkboxes for depth, width, and velocity.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Riffle / Run Quality assessment table with categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes checkboxes for riffle depth and substrate.

6) GRADIENT (1.6 ft/mi) DRAINAGE AREA (1700 mi^2) VERY LOW - LOW [2-4] MODERATE [6-10] HIGH - VERY HIGH [10-6]

%POOL: %GLIDE: %RUN: %RIFFLE:

Gradient Maximum 10

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- 1st - sample pass-- 2nd
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

CLARITY

- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

canopy

- 85%-OPEN
- 55%-85%
- 30%-55%
- 10%-30%
- <10%-CLOSED

canopy

- 1st cm
- 2nd cm

CJ RECREATION

AREA DEPTH

- >100ft²
- >3ft

BI/AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUND / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

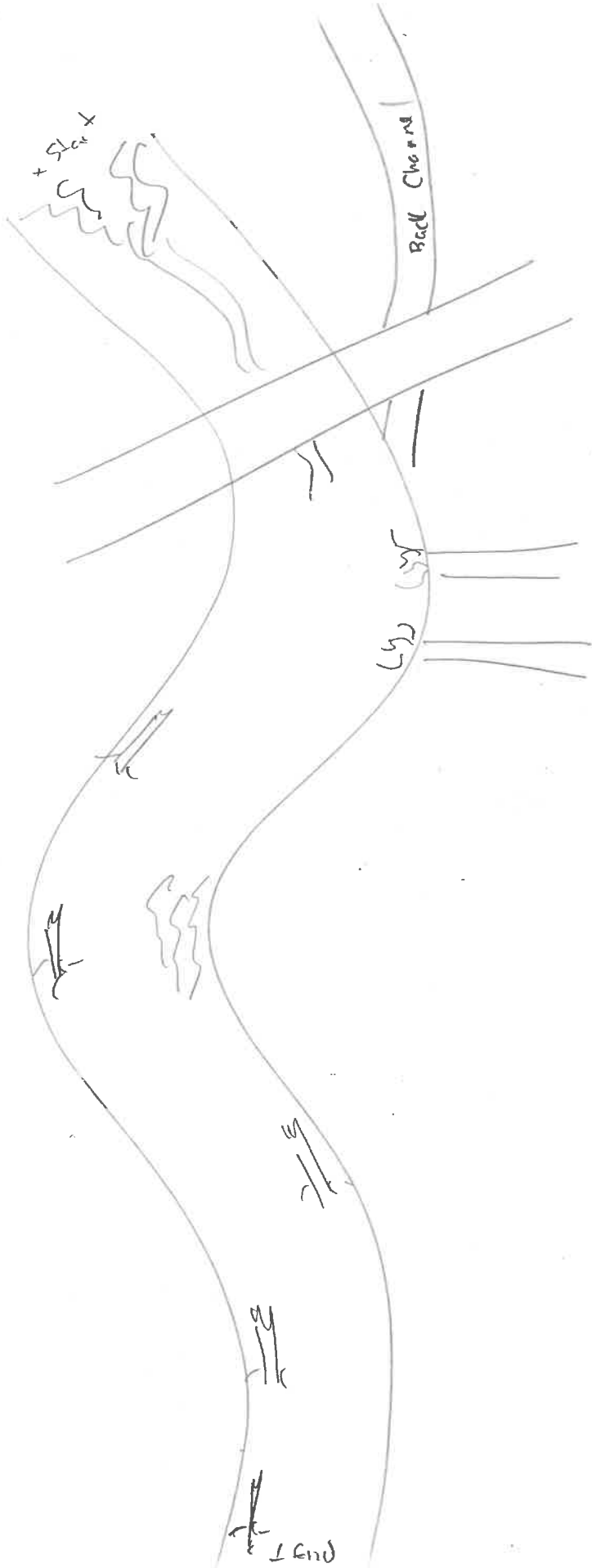
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- rmax. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Sucoto River - dst. Southerly WWTP **RM:** 118.0 **Date:** 8/08/2022
SR12
Scorers Full Name & Affiliation: MOI-MAS
River Code: 02-001- **STORET#:** _____ **Lat/Long:** 39.80933 183.01583 (NAD 83 - decimal) **Office verified location**

1) SUBSTRATE Check **ONLY** Two substrate **TYPE BOXES**; estimate % or note every type present

BEST TYPES		POOL RIFFLE	OTHER TYPES		POOL RIFFLE	ORIGIN		QUALITY	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

NUMBER OF BEST TYPES: 4 or more [2] 3 or less [0]

Comments

Substrate
14
 Maximum 20

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

<u>1</u> UNDERCUT BANKS [1]	<u>3</u> POOLS > 70cm [2]	<u>3</u> OXBOWS, BACKWATERS [1]	AMOUNT
<u>1</u> OVERHANGING VEGETATION [1]	<u>3</u> ROOTWADS [1]	<u>0</u> AQUATIC MACROPHYTES [1]	<input type="checkbox"/> EXTENSIVE >75% [11]
<u>3</u> SHALLOWS (IN SLOW WATER) [1]	<u>2</u> BOULDERS [1]	<u>3</u> LOGS OR WOODY DEBRIS [1]	<input checked="" type="checkbox"/> MODERATE 25-75% [7]
<u>3</u> ROOTMATS [1]			<input type="checkbox"/> SPARSE 5-<25% [3]
			<input type="checkbox"/> NEARLY ABSENT <5% [1]

Comments

Cover
17
 Maximum 20

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
<input type="checkbox"/> HIGH [4]	<input type="checkbox"/> EXCELLENT [7]	<input checked="" type="checkbox"/> NONE [6]	<input type="checkbox"/> HIGH [3]
<input checked="" type="checkbox"/> MODERATE [3]	<input checked="" type="checkbox"/> GOOD [5]	<input type="checkbox"/> RECOVERED [4]	<input checked="" type="checkbox"/> MODERATE [2]
<input type="checkbox"/> LOW [2]	<input type="checkbox"/> FAIR [3]	<input type="checkbox"/> RECOVERING [3]	<input type="checkbox"/> LOW [1]
<input type="checkbox"/> NONE [1]	<input type="checkbox"/> POOR [1]	<input type="checkbox"/> RECENT OR NO RECOVERY [1]	

Comments

Channel
10
 Maximum 20

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for **EACH BANK** (Or 2 per bank & average)

River right looking downstream

EROSION	RIPARIAN WIDTH	FLOOD PLAIN QUALITY	CONSERVATION
<input type="checkbox"/> NONE / LITTLE [3]	<input checked="" type="checkbox"/> WIDE > 50m [4]	<input type="checkbox"/> FOREST, SWAMP [3]	<input type="checkbox"/> CONSERVATION TILLAGE [1]
<input checked="" type="checkbox"/> MODERATE [2]	<input checked="" type="checkbox"/> MODERATE 10-50m [3]	<input type="checkbox"/> SHRUB OR OLD FIELD [2]	<input type="checkbox"/> URBAN OR INDUSTRIAL [0]
<input type="checkbox"/> HEAVY / SEVERE [1]	<input checked="" type="checkbox"/> NARROW 5-10m [2]	<input type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1]	<input type="checkbox"/> MINING / CONSTRUCTION [0]
	<input type="checkbox"/> VERY NARROW < 5m [1]	<input type="checkbox"/> FENCED PASTURE [1]	
	<input type="checkbox"/> NONE [0]	<input checked="" type="checkbox"/> OPEN PASTURE, ROWCROP [0]	

Comments

Riparian
4.5
 Maximum 10

5) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH Check ONE (ONLY!)	CHANNEL WIDTH Check ONE (Or 2 & average)	CURRENT VELOCITY Check ALL that apply	Recreation Potential
<input checked="" type="checkbox"/> > 1m [6]	<input type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2]	<input type="checkbox"/> TORRENTIAL [-1]	Primary Contact
<input type="checkbox"/> 0.7-<1m [4]	<input type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1]	<input checked="" type="checkbox"/> SLOW [1]	Secondary Contact
<input type="checkbox"/> 0.4-<0.7m [2]	<input checked="" type="checkbox"/> POOL WIDTH < RIFFLE WIDTH [0]	<input type="checkbox"/> VERY FAST [1]	(circle one and comment on back)
<input type="checkbox"/> 0.2-<0.4m [1]		<input type="checkbox"/> FAST [1]	
<input type="checkbox"/> < 0.2m [0]		<input checked="" type="checkbox"/> MODERATE [1]	
		<input checked="" type="checkbox"/> INTERSTITIAL [-1]	
		<input type="checkbox"/> INTERMITTENT [-2]	
		<input checked="" type="checkbox"/> EDDIES [1]	

Comments

Pool / Current
9
 Maximum 12

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
<input type="checkbox"/> BEST AREAS > 10cm [2]	<input type="checkbox"/> MAXIMUM > 50cm [2]	<input type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2]	<input type="checkbox"/> NONE [2]
<input type="checkbox"/> BEST AREAS 5-10cm [1]	<input type="checkbox"/> MAXIMUM < 50cm [1]	<input type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1]	<input type="checkbox"/> LOW [1]
<input checked="" type="checkbox"/> BEST AREAS < 5cm [metric=0]		<input type="checkbox"/> UNSTABLE (e.g., Fine Gravel, Sand) [0]	<input type="checkbox"/> MODERATE [0]
			<input type="checkbox"/> EXTENSIVE [-1]

Comments

Riffle / Run
0
 Maximum 8

6) GRADIENT (1.0 ft/mi) VERY LOW - LOW [2-4] MODERATE [6-10] HIGH - VERY HIGH [10-6]

DRAINAGE AREA (1710 mi²)

%POOL: 2 **%GLIDE:** 0

%RUN: 0 **%RIFFLE:** 0

Gradient
10
 Maximum 10

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- 1st--sample pass-- 2nd
- HIGH
- UP
- NORMAL
- LOW
- DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- <20 cm
- 20-<40 cm
- 40-70 cm
- >70 cm/CTB
- SECCHI DEPTH

meters

CANOPY

- > 85% - OPEN
- 55% -<85%
- 30% -<55%
- 10% -<30%
- <10% - CLOSED

BIAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUND / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

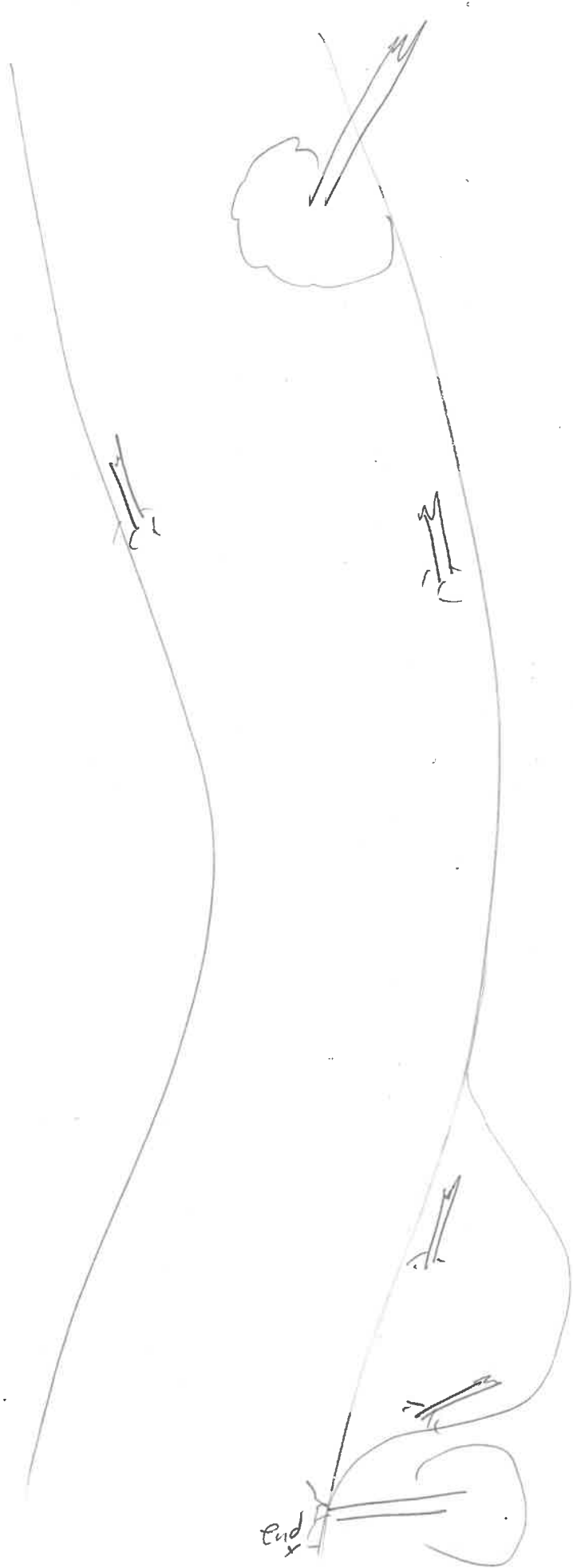
Legacy Tree:

CJ RECREATION

AREA DEPTH

POOL: >100R2 >3R

Stream Drawing:



Stream & Location: Scioto River Dets Walnut Creek RM: 117.15 Date: 8/08/2022
 SR13

River Code: 02-001- STORET #: _____ Scorer's Full Name & Affiliation: MBI-MAS
 Lat./Long.: 39.79924 183.01015 Office verified location

1] SUBSTRATE Check ONLY two substrate TYPE BOXES; estimate % or note every type present

<p>BEST TYPES</p> <input type="checkbox"/> BLDG/SLABS [10] <input type="checkbox"/> BOULDER [9] <input type="checkbox"/> COBBLE [8] <input checked="" type="checkbox"/> GRAVEL [7] <input checked="" type="checkbox"/> SAND [6] <input type="checkbox"/> BEDROCK [5]	<p>POOL RIFFLE</p> <table border="0"> <tr><td>✓</td><td>_____</td></tr> <tr><td>✓</td><td>_____</td></tr> <tr><td>✓</td><td>_____</td></tr> <tr><td>✓</td><td>_____</td></tr> </table>	✓	_____	✓	_____	✓	_____	✓	_____	<p>OTHER TYPES</p> <input type="checkbox"/> HARDPAN [4] <input type="checkbox"/> DETRITUS [3] <input type="checkbox"/> MUCK [2] <input type="checkbox"/> SILT [2] <input type="checkbox"/> ARTIFICIAL [0]	<p>POOL RIFFLE</p> <table border="0"> <tr><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td></tr> <tr><td>_____</td><td>_____</td></tr> </table>	_____	_____	_____	_____	_____	_____	_____	_____	<p>ORIGIN</p> <input type="checkbox"/> LIMESTONE [1] <input checked="" type="checkbox"/> TILLS [1] <input type="checkbox"/> WETLANDS [0] <input type="checkbox"/> HARDPAN [0] <input type="checkbox"/> SANDSTONE [0] <input type="checkbox"/> RIP/RAP [0] <input type="checkbox"/> LACUSTURINE [0] <input type="checkbox"/> SHALE [-1] <input type="checkbox"/> COAL FINES [-2]	<p>QUALITY</p> <input type="checkbox"/> HEAVY [-2] <input type="checkbox"/> MODERATE [-1] <input checked="" type="checkbox"/> NORMAL [0] <input type="checkbox"/> FREE [1] <input type="checkbox"/> EXTENSIVE [-2] <input type="checkbox"/> MODERATE [-1] <input checked="" type="checkbox"/> NORMAL [0] <input type="checkbox"/> NONE [1]
✓	_____																				
✓	_____																				
✓	_____																				
✓	_____																				
_____	_____																				
_____	_____																				
_____	_____																				
_____	_____																				

Check ONE (Or 2 & average)

NUMBER OF BEST TYPES: 4 or more [2] 3 or less [0] (Score natural substrates; ignore sludge from point-sources)

Comments _____

Substrate
16
 Maximum 20

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

<p>UNDERCUT BANKS [1] <u>1</u></p> <p>OVERHANGING VEGETATION [1] <u>2</u></p> <p>SHALLOWS (IN SLOW WATER) [1] <u>2</u></p> <p>ROOTMATS [1] <u>2</u></p>	<p>POOLS > 70cm [2] <u>3</u></p> <p>ROOTWADS [1] <u>2</u></p> <p>BOULDERS [1] <u>2</u></p>	<p>OXBOWS, BACKWATERS [1] <u>2</u></p> <p>AQUATIC MACROPHYTES [1] <u>0</u></p> <p>LOGS OR WOODY DEBRIS [1] <u>3</u></p>
---	--	--

Check ONE (Or 2 & average)

AMOUNT

 EXTENSIVE >75% [11]
 MODERATE 25-75% [7]
 SPARSE 5-<25% [3]
 NEARLY ABSENT <5% [1]

Comments _____

Cover
 Maximum 20
17

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

<p>SINUOSITY</p> <input type="checkbox"/> HIGH [4] <input checked="" type="checkbox"/> MODERATE [3] <input type="checkbox"/> LOW [2] <input type="checkbox"/> NONE [1]	<p>DEVELOPMENT</p> <input checked="" type="checkbox"/> EXCELLENT [7] <input type="checkbox"/> GOOD [5] <input type="checkbox"/> FAIR [3] <input type="checkbox"/> POOR [1]	<p>CHANNELIZATION</p> <input checked="" type="checkbox"/> NONE [6] <input type="checkbox"/> RECOVERED [4] <input type="checkbox"/> RECOVERING [3] <input type="checkbox"/> RECENT OR NO RECOVERY [1]	<p>STABILITY</p> <input type="checkbox"/> HIGH [3] <input checked="" type="checkbox"/> MODERATE [2] <input type="checkbox"/> LOW [1]
--	--	--	---

Comments _____

Channel
 Maximum 20
18

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

<p>EROSION</p> <input type="checkbox"/> NONE / LITTLE [3] <input checked="" type="checkbox"/> MODERATE [2] <input type="checkbox"/> HEAVY / SEVERE [1]	<p>RIPARIAN WIDTH</p> <input type="checkbox"/> WIDE > 50m [4] <input checked="" type="checkbox"/> MODERATE 10-50m [3] <input type="checkbox"/> NARROW 5-10m [2] <input type="checkbox"/> VERY NARROW < 5m [1] <input type="checkbox"/> NONE [0]	<p>FLOOD PLAIN QUALITY</p> <input type="checkbox"/> FOREST, SWAMP [3] <input type="checkbox"/> SHRUB OR OLD FIELD [2] <input type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1] <input type="checkbox"/> FENCED PASTURE [1] <input checked="" type="checkbox"/> OPEN PASTURE, ROWCROP [0]	<p>CONSERVATION TILLAGE [1] <input type="checkbox"/> URBAN OR INDUSTRIAL [0] <input type="checkbox"/> MINING / CONSTRUCTION [0]</p>
---	--	--	--

Indicate predominant land use(s) past 100m riparian.

Comments _____

Riparian
 Maximum 10
5

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

<p>MAXIMUM DEPTH Check ONE (ONLY!)</p> <input checked="" type="checkbox"/> > 1m [6] <input type="checkbox"/> 0.7-<1m [4] <input type="checkbox"/> 0.4-<0.7m [2] <input type="checkbox"/> 0.2-<0.4m [1] <input type="checkbox"/> < 0.2m [0]	<p>CHANNEL WIDTH Check ONE (Or 2 & average)</p> <input checked="" type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2] <input type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1] <input type="checkbox"/> POOL WIDTH < RIFFLE WIDTH [0]	<p>CURRENT VELOCITY Check ALL that apply</p> <input type="checkbox"/> TORRENTIAL [-1] <input type="checkbox"/> VERY FAST [1] <input checked="" type="checkbox"/> FAST [1] <input checked="" type="checkbox"/> MODERATE [1] <input checked="" type="checkbox"/> SLOW [1] <input type="checkbox"/> INTERSTITIAL [-1] <input type="checkbox"/> INTERMITTENT [-2] <input checked="" type="checkbox"/> EDDIES [1]
--	---	---

Indicate for reach - pools and riffles.

Comments _____

Recreation Potential
 Primary Contact
 Secondary Contact
 (circle one and comment on back)

Pool / Current
 Maximum 12
12

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Check ONE (Or 2 & average)

<p>RIFFLE DEPTH</p> <input checked="" type="checkbox"/> BEST AREAS > 10cm [2] <input type="checkbox"/> BEST AREAS 5-10cm [1] <input type="checkbox"/> BEST AREAS < 5cm [metric=0]	<p>RUN DEPTH</p> <input checked="" type="checkbox"/> MAXIMUM > 50cm [2] <input type="checkbox"/> MAXIMUM < 50cm [1]	<p>RIFFLE / RUN SUBSTRATE</p> <input checked="" type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2] <input checked="" type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1] <input type="checkbox"/> UNSTABLE (e.g., Fine Gravel, Sand) [0]	<p>RIFFLE / RUN EMBEDDEDNESS</p> <input type="checkbox"/> NONE [2] <input checked="" type="checkbox"/> LOW [1] <input checked="" type="checkbox"/> MODERATE [0] <input type="checkbox"/> EXTENSIVE [-1]
--	---	--	---

Comments _____

Riffle / Run
 Maximum 8
6

6] GRADIENT (1.7 ft/mi) VERY LOW - LOW [2-4] MODERATE [6-10] HIGH - VERY HIGH [10-6]
DRAINAGE AREA (2260 m²)

%POOL: 2 %GLIDE: 0
 %RUN: 0 %RIFFLE: 0

Comments _____

Gradient
 Maximum 10
10

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- 1st sample pass-- 2nd
- HIGH
- UP
- NORMAL
- LOW
- DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st sample pass-- 2nd
- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters
CANOPY 1st _____ cm
 2nd _____ cm

- > 85% - OPEN
- 55% - 85%
- 30% - 55%
- 10% - 30%
- < 10% - CLOSED

CJ RECREATION AREA DEPTH
 POOL: > 100R2 > 3ft

BIAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL-SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMOURED / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

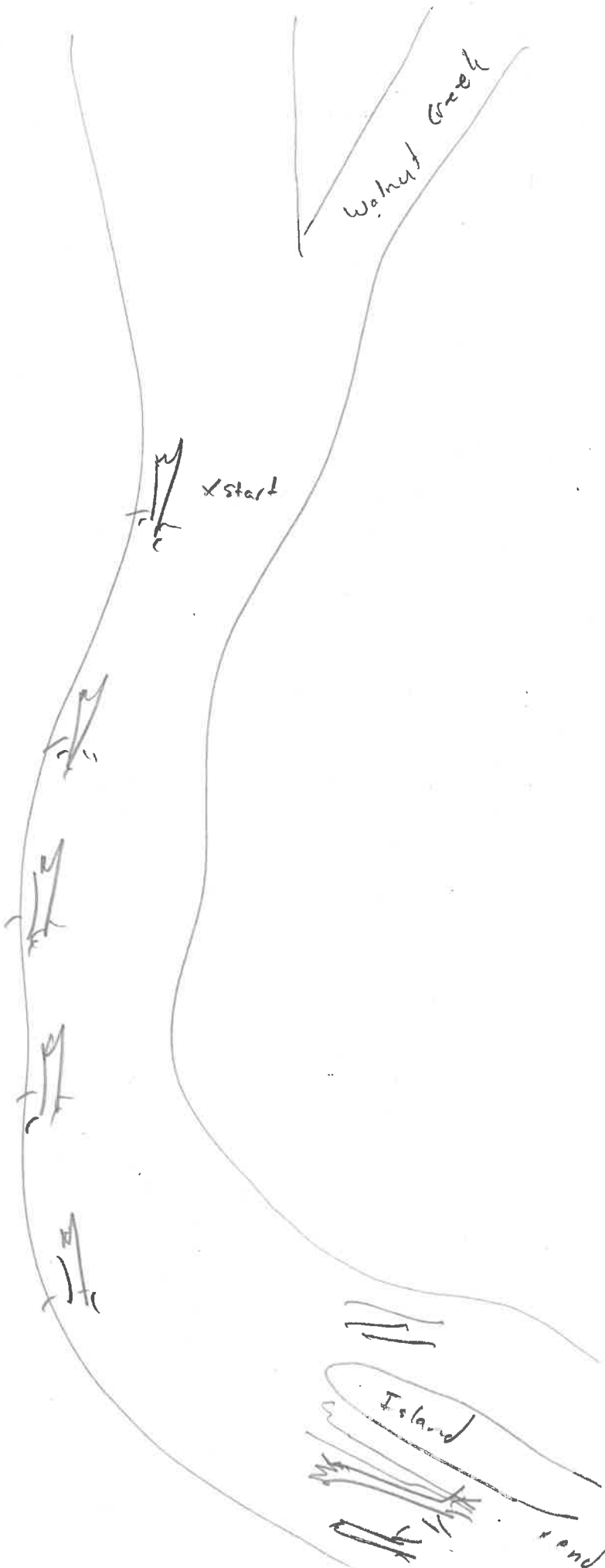
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Scioto River dst. historic Pickaway PP Int. RM: 116.0 Date: 8/08/2022
 SR14

River Code: 02-001 STORET #: _____ Lat./Long.: 39.7845 183.00990
 Scorers Full Name & Affiliation: MBI-MAS Office verified location:

1) **SUBSTRATE** Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

<p>BEST TYPES</p> <input type="checkbox"/> BLDR / SLABS [10] <input type="checkbox"/> BOULDER [9] <input type="checkbox"/> COBBLE [8] <input checked="" type="checkbox"/> GRAVEL [7] <input checked="" type="checkbox"/> SAND [6] <input type="checkbox"/> BEDROCK [5]	<p>POOL RIFFLE</p> <p style="text-align: center;">x</p> <p style="text-align: center;">x</p> <p style="text-align: center;">x</p>	<p>OTHER TYPES</p> <input type="checkbox"/> HARDPAN [4] <input type="checkbox"/> DETRITUS [3] <input type="checkbox"/> MUCK [2] <input type="checkbox"/> SILT [2] <input type="checkbox"/> ARTIFICIAL [0]	<p>POOL RIFFLE</p> <p style="text-align: center;">x</p> <p style="text-align: center;">x</p> <p style="text-align: center;">x</p>	<p>ORIGIN</p> <input type="checkbox"/> LIMESTONE [1] <input checked="" type="checkbox"/> TILLS [1] <input type="checkbox"/> WETLANDS [0] <input type="checkbox"/> HARDPAN [0] <input type="checkbox"/> SANDSTONE [0] <input type="checkbox"/> RIP/RAP [0] <input type="checkbox"/> LACUSTURINE [0] <input type="checkbox"/> SHALE [-1] <input type="checkbox"/> COAL FINES [-2]	<p>QUALITY</p> <input type="checkbox"/> HEAVY [-2] <input type="checkbox"/> MODERATE [-1] <input type="checkbox"/> NORMAL [0] <input type="checkbox"/> FREE [1] <input type="checkbox"/> EXTENSIVE [-2] <input type="checkbox"/> MODERATE [-1] <input checked="" type="checkbox"/> NORMAL [0] <input checked="" type="checkbox"/> NONE [1]	<p>EMBEDDEDNESS</p> <p style="text-align: center;">x</p> <p style="text-align: center;">x</p> <p style="text-align: center;">x</p>	<p>SILT</p> <p style="text-align: center;">x</p> <p style="text-align: center;">x</p> <p style="text-align: center;">x</p>	<p>Substrate</p> <div style="border: 1px solid black; border-radius: 50%; padding: 5px; text-align: center;"> 10.5 </div> <p>Maximum 20</p>
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Check ONE (Or 2 & average)

NUMBER OF BEST TYPES: 4 or more [2] 3 or less [0] (Score natural substrates; ignore sludge from point-sources)

Comments: _____

2) **INSTREAM COVER** Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

<p>UNDERCUT BANKS [1] 1 POOLS > 70cm [2] 3 OXBOWS, BACKWATERS [1]</p> <p>OVERHANGING VEGETATION [1] 2 ROOTWADS [1] 0 AQUATIC MACROPHYTES [1]</p> <p>SHALLOWS (IN SLOW WATER) [1] 2 BOULDERS [1] 3 LOGS OR WOODY DEBRIS [1]</p> <p>ROOTMATS [1]</p>	<p>AMOUNT</p> <p>Check ONE (Or 2 & average)</p> <input type="checkbox"/> EXTENSIVE >75% [11] <input checked="" type="checkbox"/> MODERATE 25-75% [7] <input type="checkbox"/> SPARSE 5-<25% [3] <input type="checkbox"/> NEARLY ABSENT <5% [1]	<p>Cover</p> <div style="border: 1px solid black; border-radius: 50%; padding: 5px; text-align: center;"> 17 </div> <p>Maximum 20</p>
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Comments: _____

3) **CHANNEL MORPHOLOGY** Check ONE in each category (Or 2 & average)

<p>SINUOSITY</p> <input checked="" type="checkbox"/> HIGH [4] <input type="checkbox"/> MODERATE [3] <input type="checkbox"/> LOW [2] <input type="checkbox"/> NONE [1]	<p>DEVELOPMENT</p> <input checked="" type="checkbox"/> EXCELLENT [7] <input type="checkbox"/> GOOD [5] <input type="checkbox"/> FAIR [3] <input type="checkbox"/> POOR [1]	<p>CHANNELIZATION</p> <input checked="" type="checkbox"/> NONE [6] <input type="checkbox"/> RECOVERED [4] <input type="checkbox"/> RECOVERING [3] <input type="checkbox"/> RECENT OR NO RECOVERY [1]	<p>STABILITY</p> <input checked="" type="checkbox"/> HIGH [3] <input type="checkbox"/> MODERATE [2] <input type="checkbox"/> LOW [1]	<p>Channel</p> <div style="border: 1px solid black; border-radius: 50%; padding: 5px; text-align: center;"> 20 </div> <p>Maximum 20</p>
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Comments: _____

4) **BANK EROSION AND RIPARIAN ZONE** Check ONE in each category for EACH BANK (Or 2 per bank & average)

<p>EROSION</p> <input type="checkbox"/> NONE / LITTLE [3] <input checked="" type="checkbox"/> MODERATE [2] <input type="checkbox"/> HEAVY / SEVERE [1]	<p>RIPARIAN WIDTH</p> <input type="checkbox"/> WIDE > 50m [4] <input type="checkbox"/> MODERATE 10-50m [3] <input checked="" type="checkbox"/> NARROW 5-10m [2] <input type="checkbox"/> VERY NARROW < 5m [1] <input type="checkbox"/> NONE [0]	<p>FLOOD PLAIN QUALITY</p> <input type="checkbox"/> FOREST, SWAMP [3] <input type="checkbox"/> SHRUB OR OLD FIELD [2] <input type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1] <input type="checkbox"/> FENCED PASTURE [1] <input checked="" type="checkbox"/> OPEN PASTURE, ROWCROP [0]	<p>CONSERVATION TILLAGE [1] <input type="checkbox"/> URBAN OR INDUSTRIAL [0] <input type="checkbox"/> MINING / CONSTRUCTION [0]</p> <p>Indicate predominant land use(s) past 100m riparian.</p>	<p>Riparian</p> <div style="border: 1px solid black; border-radius: 50%; padding: 5px; text-align: center;"> 4 </div> <p>Maximum 10</p>
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Comments: _____

5) **POOL / GLIDE AND RIFFLE / RUN QUALITY**

<p>MAXIMUM DEPTH</p> <p>Check ONE (ONLY!)</p> <input checked="" type="checkbox"/> > 1m [6] <input type="checkbox"/> 0.7-1m [4] <input type="checkbox"/> 0.4-0.7m [2] <input type="checkbox"/> 0.2-0.4m [1] <input type="checkbox"/> < 0.2m [0]	<p>CHANNEL WIDTH</p> <p>Check ONE (Or 2 & average)</p> <input type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2] <input type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1] <input checked="" type="checkbox"/> POOL WIDTH < RIFFLE WIDTH [0]	<p>CURRENT VELOCITY</p> <p>Check ALL that apply</p> <input type="checkbox"/> TORRENTIAL [-1] <input checked="" type="checkbox"/> VERY FAST [1] <input checked="" type="checkbox"/> FAST [1] <input checked="" type="checkbox"/> MODERATE [1]	<p>Indicate for reach - pools and riffles.</p> <input checked="" type="checkbox"/> SLOW [1] <input type="checkbox"/> INTERSTITIAL [-1] <input type="checkbox"/> INTERMITTENT [-2] <input checked="" type="checkbox"/> EDDIES [1]	<p>Recreation Potential</p> <p>Primary Contact Secondary Contact (circle one and comment on back)</p> <p>Pool / Current</p> <div style="border: 1px solid black; border-radius: 50%; padding: 5px; text-align: center;"> 11 </div> <p>Maximum 12</p>
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Comments: _____

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

<p>RIFFLE DEPTH</p> <input checked="" type="checkbox"/> BEST AREAS > 10cm [2] <input type="checkbox"/> BEST AREAS 5-10cm [1] <input type="checkbox"/> BEST AREAS < 5cm [metric=0]	<p>RUN DEPTH</p> <input checked="" type="checkbox"/> MAXIMUM > 50cm [2] <input type="checkbox"/> MAXIMUM < 50cm [1]	<p>RIFFLE / RUN SUBSTRATE</p> <input checked="" type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2] <input type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1] <input type="checkbox"/> UNSTABLE (e.g., Fine Gravel, Sand) [0]	<p>RIFFLE / RUN EMBEDDEDNESS</p> <input checked="" type="checkbox"/> NONE [2] <input type="checkbox"/> LOW [1] <input type="checkbox"/> MODERATE [0] <input type="checkbox"/> EXTENSIVE [-1]	<p>Riffle / Run</p> <div style="border: 1px solid black; border-radius: 50%; padding: 5px; text-align: center;"> 8 </div> <p>Maximum 8</p>
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Comments: _____

<p>6) GRADIENT (1.7 ft/ml)</p> <p>DRAINAGE AREA (2270 mi²)</p>	<p><input type="checkbox"/> VERY LOW - LOW [2-4] <input type="checkbox"/> MODERATE [6-10] <input type="checkbox"/> HIGH - VERY HIGH [10-6]</p>	<p>%POOL: 3 %GLIDE: 0</p> <p>%RUN: 0 %RIFFLE: 0</p>	<p>Gradient</p> <div style="border: 1px solid black; border-radius: 50%; padding: 5px; text-align: center;"> 10 </div> <p>Maximum 10</p>
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Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH
Check ALL that apply

METHOD

- BOAT
- WADE
- I.L. LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- <20 cm
- 20-40 cm
- 40-70 cm
- >70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- >85% - OPEN
- 55%-85%
- 30%-55%
- 10%-30%
- <10% - CLOSED

1st _____ cm
2nd _____ cm

B/AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

CJ RECREATION AREA DEPTH
POOL: >100R2 >3ft

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUND / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

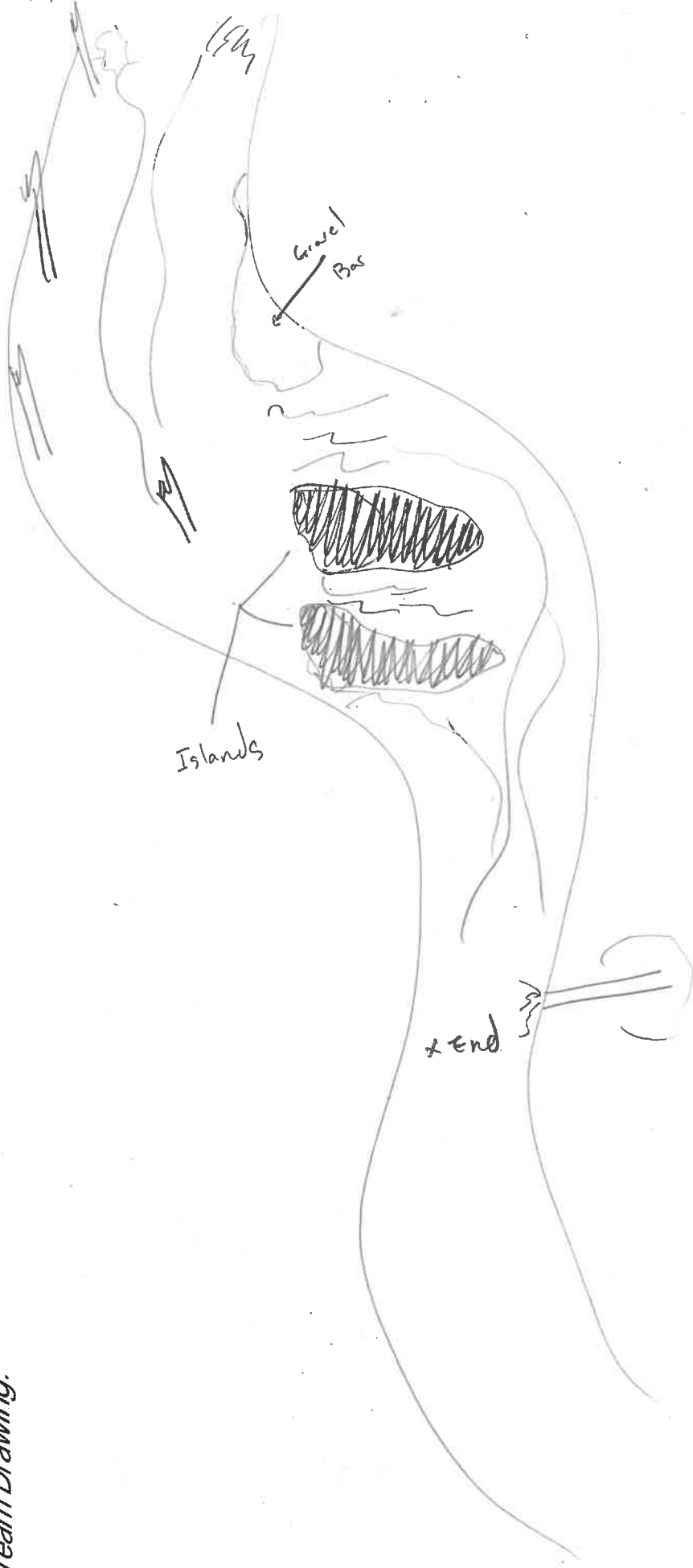
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- width
- depth
- max. depth
- bankfull width
- bankfull depth
- W/D ratio
- bankfull max. depth
- floodprone x² width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Scioto River - dst, SR 762 RM: 114.0 Date: 8/10/2022

SEIS Scorers Full Name & Affiliation: MBI- MAS

River Code: 02-001 STORET#: Lat./Long.: 39.7548 182.99931 Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. Includes categories: BEST TYPES, OTHER TYPES, ORIGIN, and QUALITY. Includes a 'Substrate' score box with value 10.

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts... Includes categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes a 'Cover' score box with value 17.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). Includes categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes a 'Channel' score box with value 18.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). Includes categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes a 'Riparian' score box with value 5.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY. Includes a 'Recreation Potential' box and a 'Pool / Current' score box with value 12.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species. Includes categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes a 'Riffle / Run' score box with value 5.

6) GRADIENT (1.7 ft/ml) DRAINAGE AREA (2280 mi^2). Includes categories: VERY LOW - LOW, MODERATE, HIGH - VERY HIGH. Includes a 'Gradient' score box with value 10.

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

1st sample pass-- 2nd

CLARITY

- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/ CTB

SECCHI DEPTH

- 1st pass _____ cm
- 2nd pass _____ cm

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%- CLOSED

C/ RECREATION

- AREA DEPTH
- POOL: >100ft? >3ft

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

E/ ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

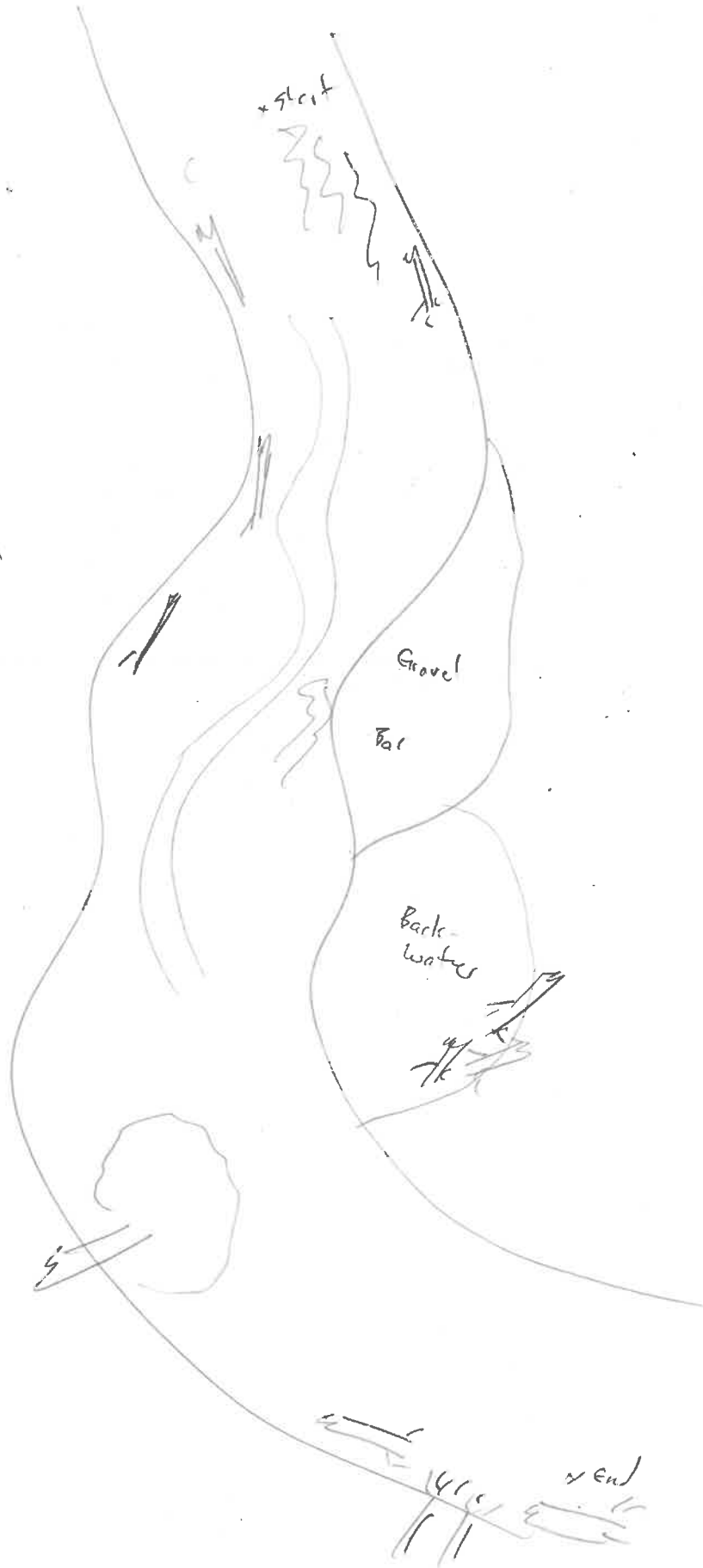
F/ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

C/ RECREATION

- AREA DEPTH
- POOL: >100ft? >3ft

Stream Drawing:



Stream & Location: Scioto River Dist OH-316 RM: 109.35 Date: 8/10/2022

SR# 5216 Scorers Full Name & Affiliation: MAS-HBI River Code: 02-001 STORET#: Lat./Long.: 39.71945 183.01266 Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. Includes categories: BEST TYPES, OTHER TYPES, ORIGIN, and QUALITY. Includes a 'Substrate' score box with value 10.

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts... Includes categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes an 'Amount' score box with value 18.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). Includes categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes a 'Channel' score box with value 18.5.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). Includes categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes a 'Riparian' score box with value 10.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY Includes categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY, and Recreation Potential. Includes a 'Pool / Current' score box with value 11.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species. Includes categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes a 'Riffle / Run' score box with value 6.5.

6) GRADIENT (1.0 ft/mi) DRAINAGE AREA (2310 mi^2) Includes categories: GRADIENT, DRAINAGE AREA, % POOL, % GLIDE, % RUN, % RIFFLE. Includes a 'Gradient' score box with value 8.

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85% - OPEN
- 55% -< 85%
- 30% -< 55%
- 10% -< 30%
- < 10% - CLOSED

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMORED / SLUMPS
- ISLANDS / SCOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

CJ RECREATION

AREA DEPTH
POOL: >100ft² >3ft

E/ISSUES

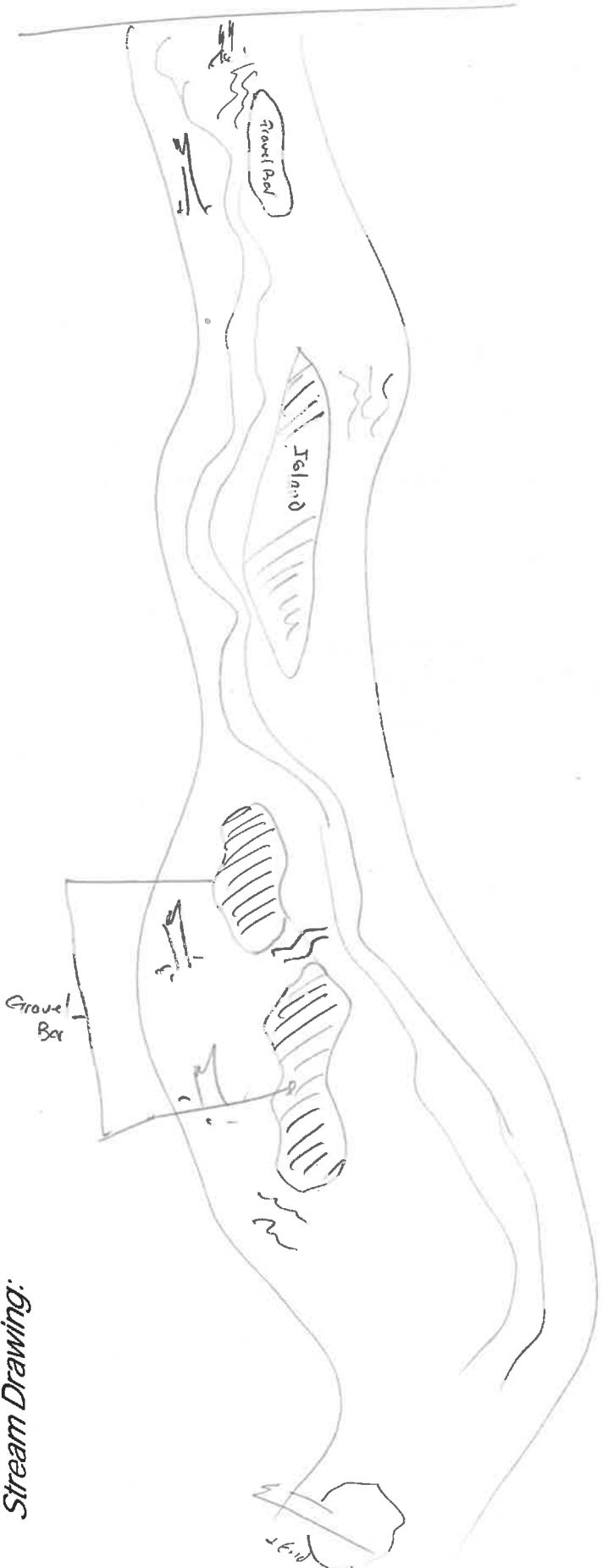
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Scioto River ust. Walnut Creek RM: 107.5 Date: 8/10/2022

River Code: 02-001 STORET #: Lat./Long.: 39.69682 183.00347 Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Substrate assessment table with categories: BEST TYPES, OTHER TYPES, ORIGIN, QUALITY. Includes checkboxes for BLDR/SLABS, BOULDER, COBBLE, GRAVEL, SAND, BEDROCK, etc.

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts

Instream Cover assessment table with categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS > 70cm, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel Morphology assessment table with categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes checkboxes for HIGH, MODERATE, LOW, NONE.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Bank Erosion and Riparian Zone assessment table with categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes checkboxes for NONE, MODERATE, HEAVY/SEVERE.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY

Pool/Glide and Riffle/Run Quality assessment table with categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY, Recreation Potential. Includes checkboxes for depth and velocity.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Riffle/Run Quality assessment table with categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes checkboxes for riffle characteristics.

Gradient and Drainage Area assessment table with categories: GRADIENT, DRAINAGE AREA. Includes input fields for values and checkboxes for gradient levels.

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

1st-sample pass-- 2nd

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%- CLOSED

CJ RECREATION

AREA DEPTH
POOL: >100ft² >3ft

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

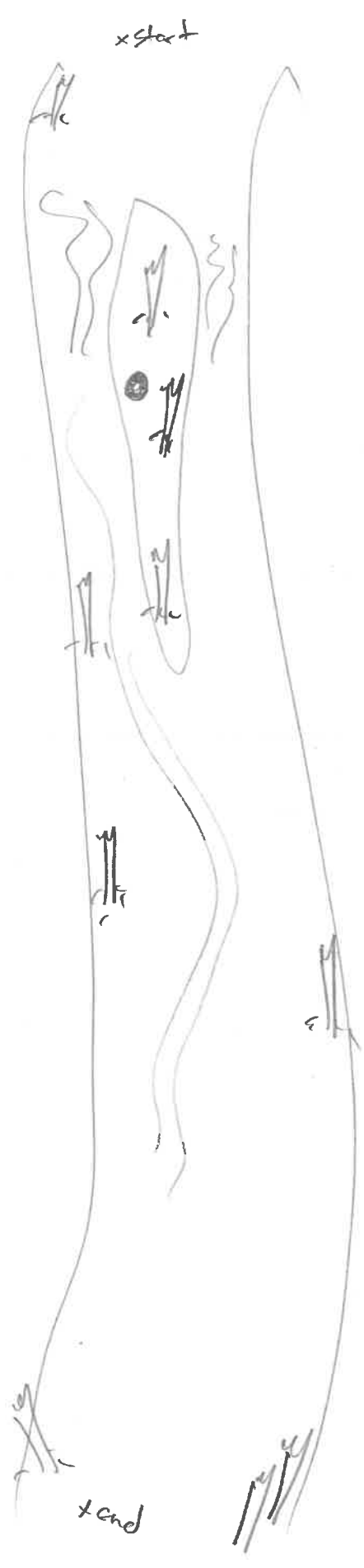
- WWTP / CSO / NPDES / INDUSTRY
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- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Scioto River dist. Walnut Creek RM: 105.25 Date: 8/10/2022

5218

Scorers Full Name & Affiliation: MBI-MAS

River Code: 02-001 STORET #: Lat./Long.: 39.67098 182.99101 Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Check ONE (Or 2 & average)

Substrate assessment grid with categories: BEST TYPES, OTHER TYPES, POOL RIFFLE, ORIGIN, QUALITY. Includes checkboxes for BDR/SLABS, BOULDER, COBBLE, GRAVEL, SAND, BEDROCK, etc.

NUMBER OF BEST TYPES: 4 or more [2] 3 or less [0]

Comments

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts

AMOUNT

Check ONE (Or 2 & average)

Instream Cover assessment grid with categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS > 70cm, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS.

Comments

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel Morphology assessment grid with categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY.

Comments

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

Bank Erosion and Riparian Zone assessment grid with categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY, CONSERVATION TILLAGE, URBAN OR INDUSTRIAL, MINING / CONSTRUCTION.

Comments

5) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH

CHANNEL WIDTH

CURRENT VELOCITY

Check ONE (ONLY!)

Check ONE (Or 2 & average)

Check ALL that apply

Pool/Glide and Riffle/Run Quality assessment grid with checkboxes for depth, width, and velocity categories.

Comments

Recreation Potential Primary Contact Secondary Contact

Pool / Current Maximum 12

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Check ONE (Or 2 & average)

NO RIFFLE [metric=0]

Riffle assessment grid with categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS.

Comments

6) GRADIENT (1.0 ft/ml) DRAINAGE AREA (2610 mi^2)

%POOL: %GLIDE: %RUN: %RIFFLE:

Gradient Maximum 10

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

A) SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

1st-sample pass--2nd

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/CTB
- SECCHI DEPTH

meters

CANOPY

- > 85% - OPEN
- 55% - 85%
- 30% - 55%
- 10% - 30%
- < 10% - CLOSED

1st ssed 2nd

cm

cm

CJ RECREATION

AREA DEPTH POOL: >100ft? >3ft

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPounded / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

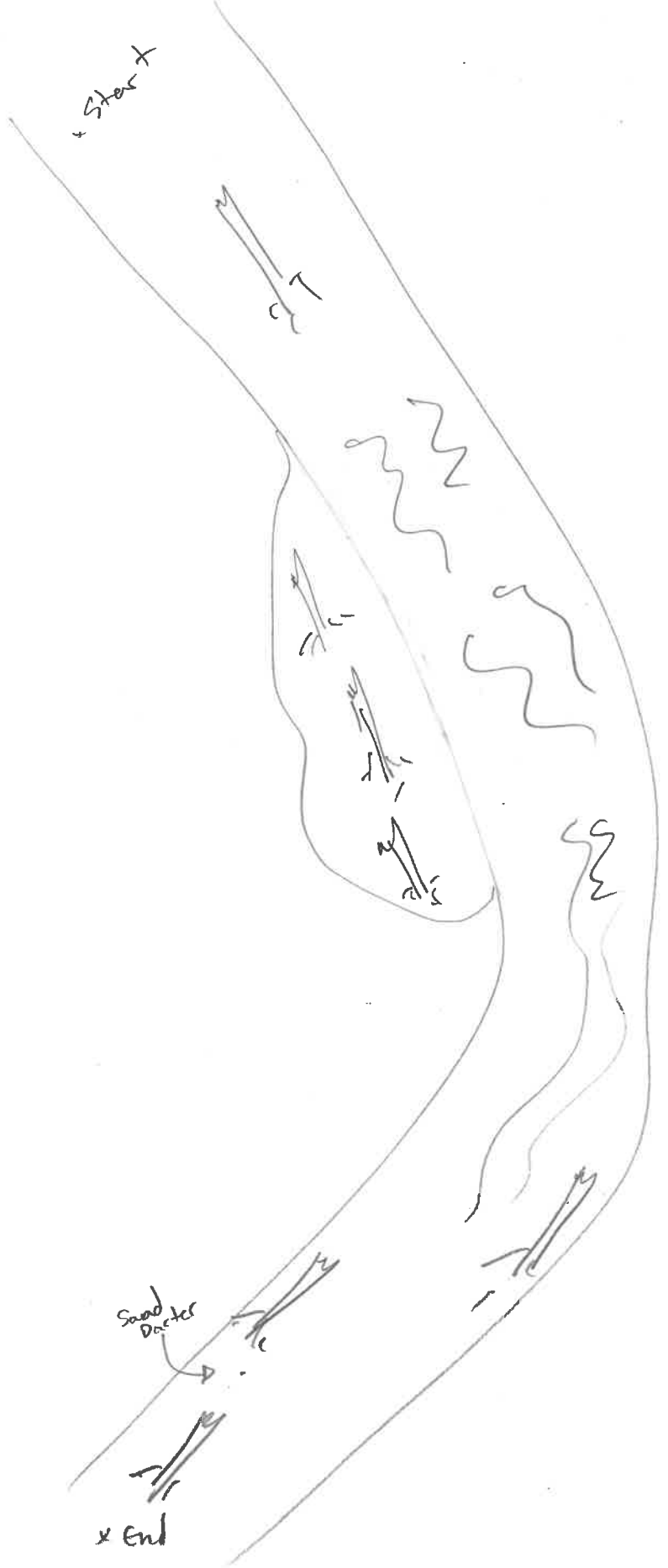
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Scioto River dst. Commercial Point Rd. RM: 102.0 Date: 8/10/2022

SL19

Scorers Full Name & Affiliation: MBI-MAS

River Code: 02-001- STORET#: Lat./Long.: 39.63284 182.96212 Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Substrate assessment section with categories: BEST TYPES, OTHER TYPES, ORIGIN, and QUALITY. Includes checkboxes for various substrate types and a score box for the overall quality.

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts

Instream Cover assessment section with categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes checkboxes and a score box.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel Morphology assessment section with categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, and STABILITY. Includes checkboxes and a score box.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Bank Erosion and Riparian Zone assessment section with categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY, and CONSERVATION TILLAGE. Includes checkboxes and a score box.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY

Pool / Glide and Riffle / Run Quality assessment section with categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY, and Recreation Potential. Includes checkboxes and a score box.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Riffle / Run Quality assessment section with categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, and RIFFLE / RUN EMBEDDEDNESS. Includes checkboxes and a score box.

Gradient and Drainage Area assessment section with categories: GRADIENT and DRAINAGE AREA. Includes input fields and a score box.

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

A) SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- 1st-sample pass-- 2nd
- HIGH
- UP
- NORMAL
- LOW
- DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- < 20 cm
- 20-<40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%- CLOSED

CJ RECREATION

AREA DEPTH POOL: >100ft² >3ft

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPounded / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

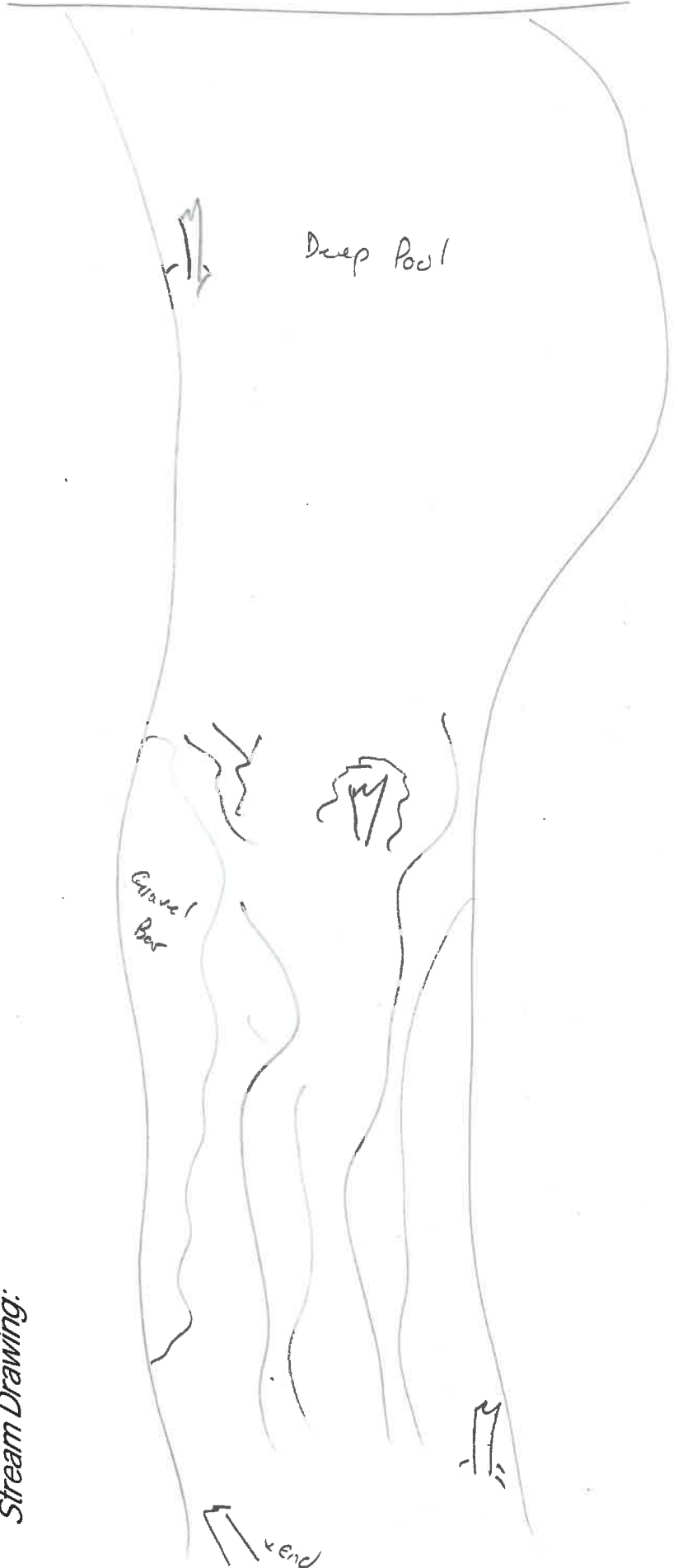
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



13 RENEWAL

Stream & Location: Scioto R. - CIRCLEVILLE RIFFLE RM: 100-24 Date: 09/01/08

ust. US-22 Scorers Full Name & Affiliation: CHRIS YODER, MBI

River Code: 02-001- STORET#: Lat./Long.: 39.60781 182.95931 Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. Check ONE (Or 2 & average). BEST TYPES: BLDR / SLABS [10], BOULDER [9], COBBLE [8], GRAVEL [7], SAND [6], BEDROCK [5]. OTHER TYPES: HARDPAN [4], DETRITUS [3], MUCK [2], SILT [2], ARTIFICIAL [0]. ORIGIN: LIMESTONE [1], TILLS [1], WETLANDS [0], HARDPAN [0], SANDSTONE [0], RIP/RAP [0], LACUSTURINE [0], SHALE [-1], COAL FINES [-2]. QUALITY: HEAVY [-2], MODERATE [-1], NORMAL [0], FREE [1], EXTENSIVE [-2], MODERATE [-1], NORMAL [0], NONE [1]. NUMBER OF BEST TYPES: 4 or more [2], 3 or less [0]. Comments: Embeddness 18, Maximum 20.

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts. Check ONE (Or 2 & average). UNDERCUT BANKS [1], OVERHANGING VEGETATION [1], SHALLOWS (IN SLOW WATER) [1], ROOTMATS [1]. POOLS > 70cm [2], ROOTWADS [1], BOULDERS [1]. OXBOWS, BACKWATERS [1], AQUATIC MACROPHYTES [1], LOGS OR WOODY DEBRIS [1]. AMOUNT: EXTENSIVE >75% [11], MODERATE 25-75% [7], SPARSE 5-<25% [3], NEARLY ABSENT <5% [1]. Comments: Cover Maximum 20.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). SINUOSITY: HIGH [4], MODERATE [3], LOW [2], NONE [1]. DEVELOPMENT: EXCELLENT [7], GOOD [5], FAIR [3], POOR [1]. CHANNELIZATION: NONE [6], RECOVERED [4], RECOVERING [3], RECENT OR NO RECOVERY [1]. STABILITY: HIGH [3], MODERATE [2], LOW [1]. Comments: Channel Maximum 20.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). River right looking downstream. EROSION: NONE / LITTLE [3], MODERATE [2], HEAVY / SEVERE [1]. RIPARIAN WIDTH: WIDE > 50m [4], MODERATE 10-50m [3], NARROW 5-10m [2], VERY NARROW < 5m [1], NONE [0]. FLOOD PLAIN QUALITY: FOREST, SWAMP [3], SHRUB OR OLD FIELD [2], RESIDENTIAL, PARK, NEW FIELD [1], FENCED PASTURE [1], OPEN PASTURE, ROWCROP [0]. CONSERVATION TILLAGE [1], URBAN OR INDUSTRIAL [0], MINING / CONSTRUCTION [0]. Indicate predominant land use(s) past 100m riparian. Comments: Riparian Maximum 10.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH: > 1m [6], 0.7-<1m [4], 0.4-<0.7m [2], 0.2-<0.4m [1], < 0.2m [0]. CHANNEL WIDTH: POOL WIDTH > RIFFLE WIDTH [2], POOL WIDTH = RIFFLE WIDTH [1], POOL WIDTH < RIFFLE WIDTH [0]. CURRENT VELOCITY: TORRENTIAL [-1], VERY FAST [1], FAST [1], MODERATE [1], SLOW [1], INTERSTITIAL [-1], INTERMITTENT [-2], EDDIES [1]. Indicate for reach - pools and riffles. Recreation Potential: Primary Contact, Secondary Contact. Comments: Pool / Current Maximum 12.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). RIFFLE DEPTH: BEST AREAS > 10cm [2], BEST AREAS 5-10cm [1], BEST AREAS < 5cm [metric=0]. RUN DEPTH: MAXIMUM > 50cm [2], MAXIMUM < 50cm [1]. RIFFLE / RUN SUBSTRATE: STABLE (e.g., Cobble, Boulder) [2], MOD. STABLE (e.g., Large Gravel) [1], UNSTABLE (e.g., Fine Gravel, Sand) [0]. RIFFLE / RUN EMBEDDEDNESS: NONE [2], LOW [1], MODERATE [0], EXTENSIVE [-1]. Comments: Riffle / Run Maximum 8.

6) GRADIENT (1.7 ft/mi) DRAINAGE AREA (3200 mi^2). VERY LOW - LOW [2-4], MODERATE [6-10], HIGH - VERY HIGH [10-6]. %POOL: 70, %GLIDE: -, %RUN: 20, %RIFFLE: 10. Gradient Maximum 10.

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/Observed - Inferred, Other/Sampling observations, Concerns, Access directions, etc.
 MOSTLY THE SAME EXCEPT POINT BAR HAS EXTENDED DIST. FURTHER AND ALSO "DEEPER"

AJ SAMPLED REACH
 Check ALL that apply

METHOD

- BOAT
 WADE
 L. LINE
 OTHER
- DISTANCE**
- 0.5 Km
 0.2 Km
 0.15 Km
 0.12 Km
 OTHER

CLARITY

- 1st --sample pass-- 2nd
- HIGH
 UP
 NORMAL
 LOW
 DRY
- < 20 cm
 20-40 cm
 40-70 cm
 > 70 cm/ CTB
- SECHI DEPTH

CANOPY

- > 85%- OPEN
 55%-85%
 30%-55%
 10%-30%
 <10%- CLOSED

C/ RECREATION

- AREA DEPTH
 POOL: >100ft² >3ft

BJAESTHETICS

- NUISANCE ALGAE
 INVASIVE MACROPHYTES
 EXCESS TURBIDITY
 DISCOLORATION
 FOAM / SCUM
 OIL SHEEN
 TRASH / LITTER
 NUISANCE ODOR
 SLUDGE DEPOSITS
 CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
 ACTIVE / HISTORIC / BOTH / NA
 YOUNG-SUCCESSION-OLD
 SPRAY / SNAG / REMOVED
 MODIFIED / DIPPED OUT / NA
 (LEVEED) / ONE SIDED
 RELOCATED / CUTOFFS
 MOVING-BEDLOAD-STABLE
 ARMoured / SLUMPS
 (ISLANDS) SCoured
 IMPOUNDED / DESICCATED
 FLOOD CONTROL / DRAINAGE

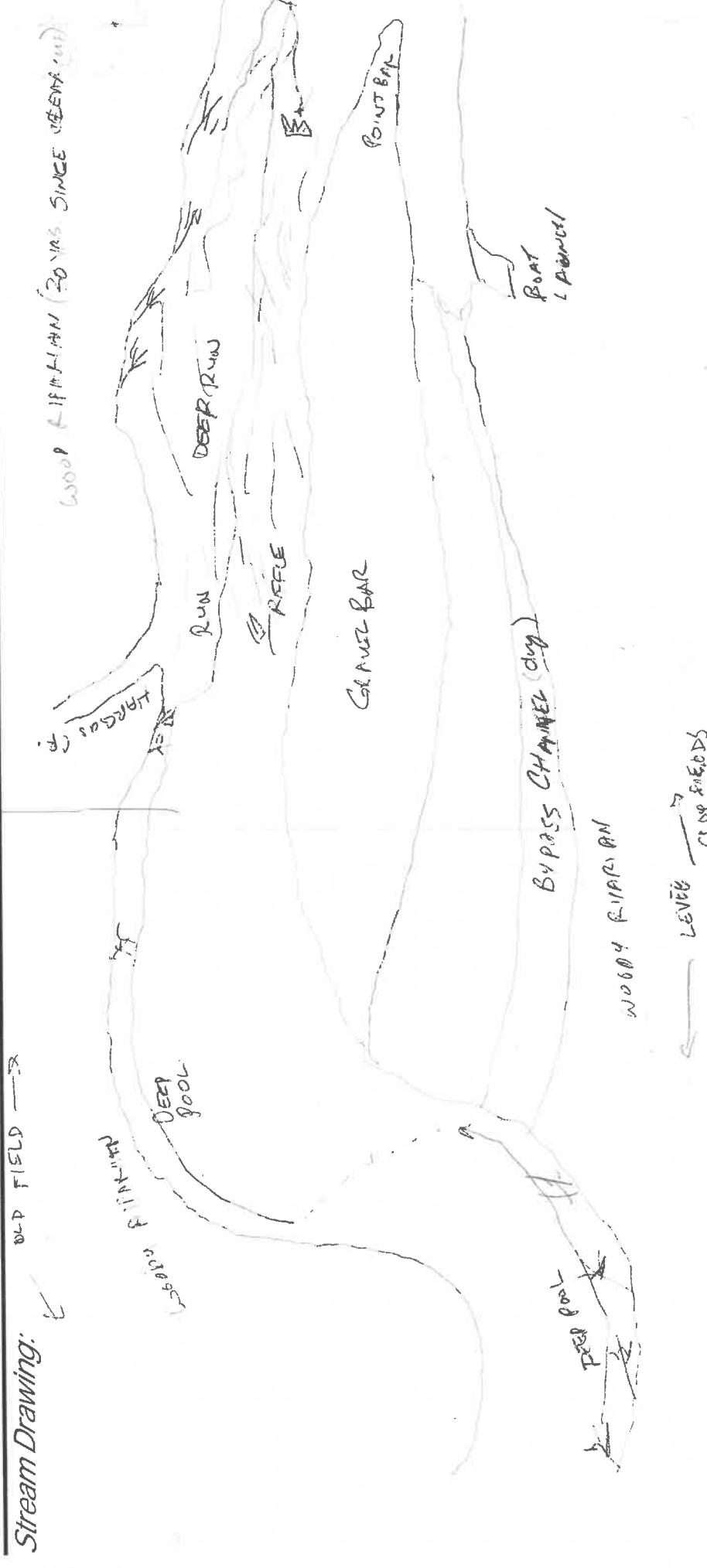
EJ ISSUES

- WWTP / CSO / NPDES / INDUSTRY
 HARDENED / URBAN / DIRT&GRIME
 CONTAMINATED / LANDFILL
 BMPs-CONSTRUCTION-SEDIMENT
 LOGGING / IRRIGATION / COOLING
 BANK EROSION / SURFACE
 FALSE BANK / MANURE / LAGOON
 WASH H₂O / TILE / H₂O TABLE
 ACID / MINE / QUARRY / FLOW
 NATURAL / WETLAND / STAGNANT
 PARK / GOLF / LAWN / HOME
 ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
 \bar{x} depth
 max. depth
 \bar{x} bankfull width
 bankfull \bar{x} depth
 W/D ratio
 bankfull max. depth
 floodprone \bar{x} width
 entrench. ratio
 Legacy Tree:

Stream Drawing:



Stream & Location: Scioto River Ust Circleville WWTP RM: 99.52 Date: 9/01/22

River Code: 02-001 STORET#: Lat/Long: 39.59769 182.95601 Office verified location

Scorers Full Name & Affiliation: MAS-MBI

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. BEST TYPES, OTHER TYPES, POOL RIFFLE, ORIGIN, QUALITY. Includes checkboxes for BLDR/SLABS, BOULDER, COBBLE, GRAVEL, SAND, BEDROCK, etc.

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts... AMOUNT. Includes checkboxes for UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS > 70cm, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS.

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes checkboxes for HIGH, MODERATE, LOW, NONE in each category.

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes checkboxes for NONE/LITTLE, MODERATE, HEAVY/SEVERE, etc.

5] POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY. Includes checkboxes for depth and width ranges, and velocity categories like TORRENTIAL, VERY FAST, FAST, MODERATE, SLOW, etc.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes checkboxes for best areas and substrate types.

6] GRADIENT (1.7 ft/ml) DRAINAGE AREA (3220 mi2). Includes checkboxes for VERY LOW - LOW, MODERATE, HIGH - VERY HIGH, and percentage fields for POOL, GLIDE, RUN, RIFFLE.

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- < 20 cm
 - 20-40 cm
 - 40-70 cm
 - > 70 cm/ CTB
 - SECCHI DEPTH
- 1st sample pass-- 2nd

CANOPY

- > 85% - OPEN
- 55% - 85%
- 30% - 55%
- 10% - 30%
- < 10% - CLOSED

CJ RECREATION

AREA DEPTH POOL: > 100ft² > 3ft

BI/AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

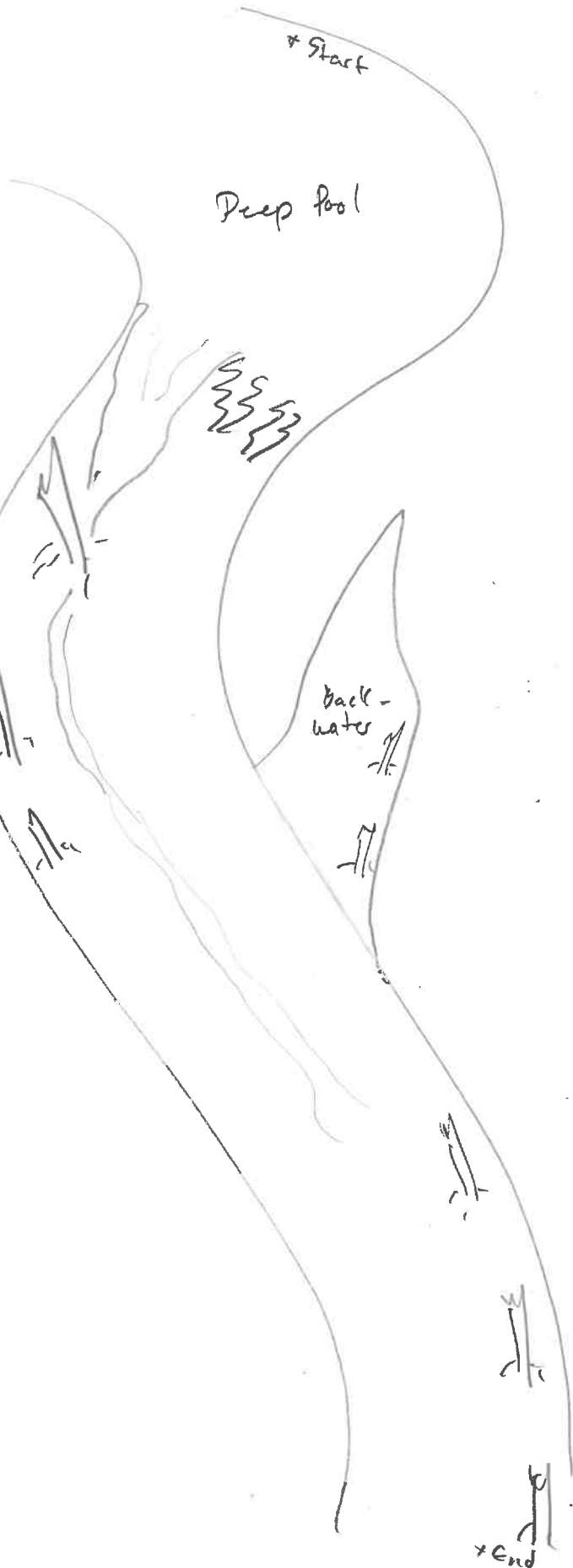
EJ ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- width
 - depth
 - max. depth
 - bankfull width
 - bankfull x depth
 - W/D ratio
 - bankfull max. depth
 - floodprone x² width
 - entrench. ratio
- Legacy Tree:

Stream Drawing:



Stream & Location: Scioto River Dist Circleville WWTP RM: 98.65 Date: 7/11/2022

SL22 Scorers Full Name & Affiliation: MAS-MB1 River Code: 02-001 STORET#: Lat/Long: 39.59874 182.97050 Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. BEST TYPES, OTHER TYPES, POOL RIFFLE, ORIGIN, QUALITY. Includes checkboxes for BLDR/SLABS, BOULDER, COBBLE, GRAVEL, SAND, BEDROCK, etc.

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts... AMOUNT. Includes checkboxes for UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, etc.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes checkboxes for HIGH, MODERATE, LOW, NONE.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes checkboxes for NONE/LITTLE, MODERATE, HEAVY/SEVERE.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY. Includes checkboxes for > 1m, 0.7-1m, 0.4-0.7m, etc.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS.

6) GRADIENT (1.7 ft/ml) DRAINAGE AREA (3220 m^2). VERY LOW - LOW, MODERATE, HIGH - VERY HIGH. Includes %POOL, %GLIDE, %RUN, %RIFFLE.

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

DISTANCE

- <0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st sample pass-- 2nd
- <20 cm
- 20-40 cm
- 40-70 cm
- >70 cm/CTB
- SECCHI DEPTH

meters

CANOPY

- >85% - OPEN
- 55%-85%
- 30%-55%
- 10%-30%
- <10% - CLOSED

CJ RECREATION

AREA DEPTH POOL: >100ft² >3ft

BI/AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

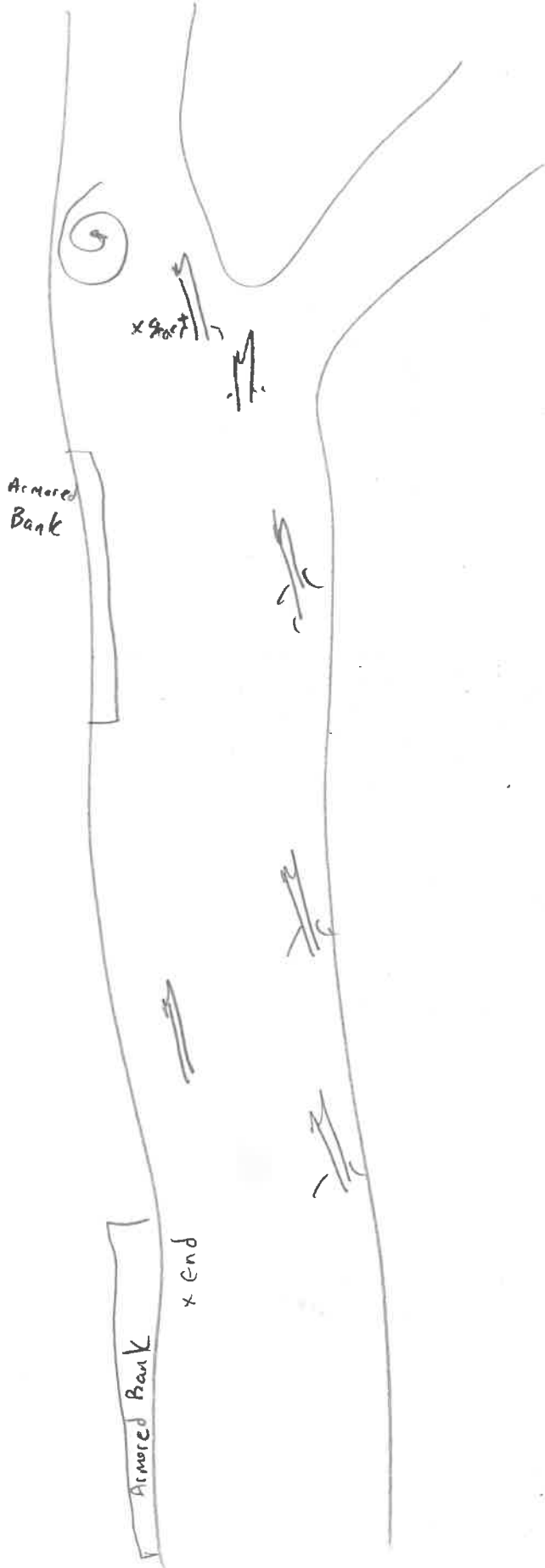
EJ ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio
- Legacy Tree:*

Stream Drawing:



Stream & Location: Scioto River Dist Wicket Dam @ Canal Park RM: 98.01 Date: 9/10/2022 SR23

River Code: 02-001 STORET#: Scorer's Full Name & Affiliation: MBI-MAS Lat/Long: 39.58976 182.97161 Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. BEST TYPES, OTHER TYPES, POOL RIFFLE, ORIGIN, QUALITY. Includes checkboxes for BLDR/SLABS, BOULDER, COBBLE, GRAVEL, SAND, BEDROCK, etc.

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts... AMOUNT. Includes checkboxes for UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS.

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes checkboxes for HIGH, MODERATE, LOW, NONE.

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes checkboxes for NONE/LITTLE, MODERATE, HEAVY/SEVERE.

5] POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY. Includes checkboxes for > 1m, 0.7-1m, 0.4-0.7m, 0.2-0.4m, < 0.2m.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS.

6] GRADIENT (1.7 ft/ml) DRAINAGE AREA (3220 mi2) VERY LOW - LOW, MODERATE, HIGH - VERY HIGH. %POOL, %GLIDE, %RUN, %RIFFLE.

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

1st-sample pass-- 2nd

CLARITY

- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/ GTB
- SECCHI DEPTH

meters

CANOPY

- > 85% - OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10% - CLOSED

CJ RECREATION

AREA DEPTH
POOL: >100ft² >3ft

BI/AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

Circle some & COMMENT

EJ ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Big Walnut Creek @ Lockbourne Rd RM: 9.8 Date: 8/09/2022

River Code: 02-100 STORET#: Lat./Long.: 39.85160 182.96840 Office verified location

Scorers Full Name & Affiliation: HBI-MAS

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. Includes categories: BEST TYPES, OTHER TYPES, POOL RIFFLE, ORIGIN, and QUALITY. Includes a 'Substrate' box with value 10.

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts... Includes categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes an 'Amount' box with value 18.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). Includes categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes a 'Channel' box with value 18.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). Includes categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes a 'Riparian' box with value 4.5.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY Includes categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY, Recreation Potential. Includes a 'Pool/Current' box with value 12.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species. Includes categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes a 'Riffle/Run' box with value 1.

6) GRADIENT (2.6 ft/ml) DRAINAGE AREA (547 mi^2) Includes categories: VERY LOW - LOW, MODERATE, HIGH - VERY HIGH. Includes a 'Gradient' box with value 8.

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st -sample pass-- 2nd
- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85% - OPEN
- 55%-85%
- 30%-55%
- 10%-30%
- <10% - CLOSED

- 1st 100 cm
- 2nd cm

CJ RECREATION

- AREA >100R² >3R
- DEPTH >100R² >3R

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

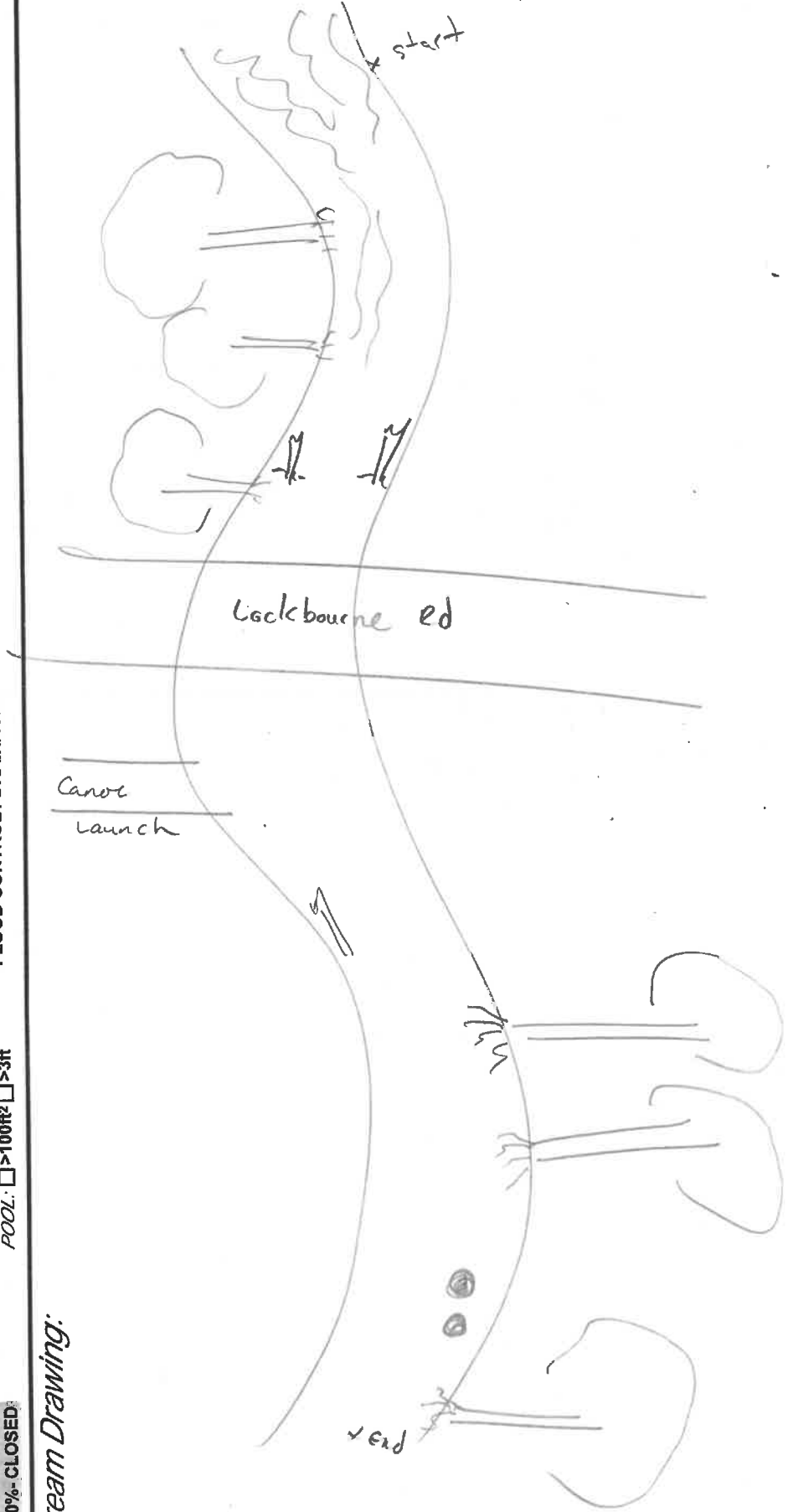
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Olentangy River Dist Dodridge Dam

RM: 3.95 Date: 9/02/2022

OLN01

Scorers Full Name & Affiliation: MBI - MAS

River Code: 02-400

STORET #:

Lat./Long.: 40

183

Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Check ONE (Or 2 & average)

Substrate assessment table with categories: BEST TYPES, OTHER TYPES, POOL RIFFLE, ORIGIN, QUALITY. Includes checkboxes for BLDR/SLABS, BOULDER, COBBLE, GRAVEL, SAND, BEDROCK, etc.

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts

AMOUNT Check ONE (Or 2 & average)

Instream Cover assessment table with categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS > 70cm, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS.

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel Morphology assessment table with categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes checkboxes for HIGH, MODERATE, LOW, NONE.

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Bank Erosion and Riparian Zone assessment table with categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes checkboxes for NONE/LITTLE, MODERATE, HEAVY/SEVERE.

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

Pool/Glide and Riffle/Run Quality assessment table with categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY. Includes checkboxes for > 1m, 0.7-1m, etc.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Riffle/Run Quality assessment table with categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes checkboxes for BEST AREAS > 10cm, etc.

6] GRADIENT (2.63 ft/ml)

Drainage Area and Gradient assessment table with categories: DRAINAGE AREA, GRADIENT. Includes checkboxes for VERY LOW - LOW, MODERATE, HIGH - VERY HIGH.

Comment RE: Reach consistency/ is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/ CTB

SECCHI DEPTH

- 1st _____ cm
- 2nd _____ cm

CANOPY

- 75-85% - OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10% - CLOSED

C1 RECREATION

- AREA >100R2 >3R
- DEPTH >100R2 >3R

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

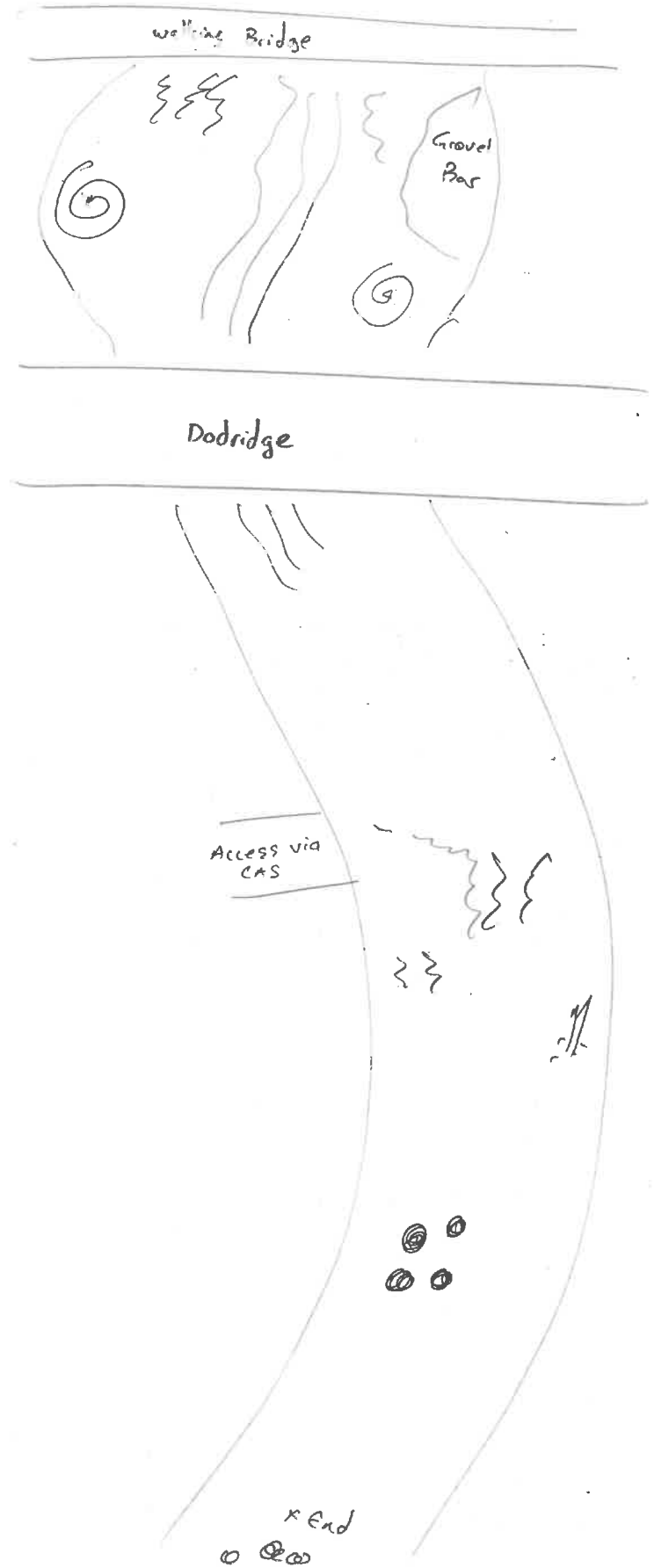
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- HARDENED / URBAN / DIRT & GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
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- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Olentary River wst. 5th Ave. RM: 2.0 Date: 8/15/2022

OLN02

Scorers Full Name & Affiliation: HBI-MAS

River Code: 02-400 STORET #: _____ Lat./Long.: 29 183 Office verified location

1) **SUBSTRATE** Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Check ONE (Or 2 & average)

BEST TYPES		POOL RIFFLE		OTHER TYPES		POOL RIFFLE		ORIGIN		QUALITY	
<input type="checkbox"/>	BLDR / SLABS [10]	<input type="checkbox"/>		<input type="checkbox"/>	HARDPAN [4]	<input type="checkbox"/>		<input checked="" type="checkbox"/>	LIMESTONE [1]	<input type="checkbox"/>	HEAVY [-2]
<input type="checkbox"/>	BOULDER [9]	<input checked="" type="checkbox"/>	<u>x</u>	<input type="checkbox"/>	DETRITUS [3]	<input type="checkbox"/>		<input checked="" type="checkbox"/>	TILLS [1]	<input type="checkbox"/>	MODERATE [-1]
<input checked="" type="checkbox"/>	COBBLE [8]	<input checked="" type="checkbox"/>	<u>x</u>	<input type="checkbox"/>	MUCK [2]	<input type="checkbox"/>		<input type="checkbox"/>	WETLANDS [0]	<input checked="" type="checkbox"/>	NORMAL [0]
<input checked="" type="checkbox"/>	GRAVEL [7]	<input checked="" type="checkbox"/>	<u>x</u>	<input type="checkbox"/>	SILT [2]	<input type="checkbox"/>	<u>2</u>	<input type="checkbox"/>	HARDPAN [0]	<input type="checkbox"/>	FREE [1]
<input type="checkbox"/>	SAND [6]	<input type="checkbox"/>	<u>2</u>	<input type="checkbox"/>	ARTIFICIAL [0]	<input type="checkbox"/>		<input type="checkbox"/>	SANDSTONE [0]	<input type="checkbox"/>	EXTENSIVE [-2]
<input type="checkbox"/>	BEDROCK [5]	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	RIP/RAP [0]	<input type="checkbox"/>	MODERATE [-1]

NUMBER OF BEST TYPES: 4 or more [2] 3 or less [0]

Comments _____

Substrate
18
Maximum 20

2) **INSTREAM COVER** Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

AMOUNT
Check ONE (Or 2 & average)

<u>0</u>	UNDERCUT BANKS [1]	<u>2</u>	POOLS > 70cm [2]	<u>0</u>	OXBOWS, BACKWATERS [1]	<input type="checkbox"/>	EXTENSIVE > 75% [11]
<u>0</u>	OVERHANGING VEGETATION [1]	<u>0</u>	ROOTWADS [1]	<u>2</u>	AQUATIC MACROPHYTES [1]	<input checked="" type="checkbox"/>	MODERATE 25-75% [7]
<u>3</u>	SHALLOWS (IN SLOW WATER) [1]	<u>2</u>	BOULDERS [1]	<u>1</u>	LOGS OR WOODY DEBRIS [1]	<input type="checkbox"/>	SPARSE 5-25% [3]
<u>0</u>	ROOTMATS [1]					<input type="checkbox"/>	NEARLY ABSENT < 5% [1]

Comments _____

Cover
Maximum 20
13

3) **CHANNEL MORPHOLOGY** Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
<input type="checkbox"/> HIGH [4]	<input type="checkbox"/> EXCELLENT [7]	<input type="checkbox"/> NONE [6]	<input checked="" type="checkbox"/> HIGH [3]
<input checked="" type="checkbox"/> MODERATE [3]	<input checked="" type="checkbox"/> GOOD [5]	<input checked="" type="checkbox"/> RECOVERED [4]	<input checked="" type="checkbox"/> MODERATE [2]
<input checked="" type="checkbox"/> LOW [2]	<input type="checkbox"/> FAIR [3]	<input type="checkbox"/> RECOVERING [3]	<input type="checkbox"/> LOW [1]
<input type="checkbox"/> NONE [1]	<input type="checkbox"/> POOR [1]	<input type="checkbox"/> RECENT OR NO RECOVERY [1]	

Comments _____

Channel
Maximum 20
14

4) **BANK EROSION AND RIPARIAN ZONE** Check ONE in each category for EACH BANK (Or 2 per bank & average)

EROSION	RIPARIAN WIDTH	FLOOD PLAIN QUALITY
<input checked="" type="checkbox"/> NONE / LITTLE [3]	<input type="checkbox"/> WIDE > 50m [4]	<input type="checkbox"/> FOREST, SWAMP [3]
<input checked="" type="checkbox"/> MODERATE [2]	<input checked="" type="checkbox"/> MODERATE 10-50m [3]	<input type="checkbox"/> SHRUB OR OLD FIELD [2]
<input type="checkbox"/> HEAVY / SEVERE [1]	<input checked="" type="checkbox"/> NARROW 5-10m [2]	<input type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1]
	<input type="checkbox"/> VERY NARROW < 5m [1]	<input type="checkbox"/> FENCED PASTURE [1]
	<input type="checkbox"/> NONE [0]	<input type="checkbox"/> OPEN PASTURE, ROWCROP [0]

Indicate predominant land use(s) past 100m riparian.

Comments _____

Riparian
Maximum 10
5

5) **POOL / GLIDE AND RIFFLE / RUN QUALITY**

MAXIMUM DEPTH	CHANNEL WIDTH	CURRENT VELOCITY	Recreation Potential
Check ONE (ONLY!)	Check ONE (Or 2 & average)	Check ALL that apply	Primary Contact
<input checked="" type="checkbox"/> > 1m [6]	<input type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2]	<input checked="" type="checkbox"/> SLOW [1]	Secondary Contact
<input checked="" type="checkbox"/> 0.7-1m [4]	<input checked="" type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1]	<input type="checkbox"/> TORRENTIAL [-1]	(circle one and comment on back)
<input type="checkbox"/> 0.4-0.7m [2]	<input type="checkbox"/> POOL WIDTH < RIFFLE WIDTH [0]	<input type="checkbox"/> VERY FAST [1]	
<input type="checkbox"/> 0.2-0.4m [1]		<input checked="" type="checkbox"/> FAST [1]	
<input type="checkbox"/> < 0.2m [0]		<input type="checkbox"/> INTERSTITIAL [-1]	
		<input checked="" type="checkbox"/> MODERATE [1]	
		<input type="checkbox"/> INTERMITTENT [-2]	
		<input type="checkbox"/> EDDIES [1]	

Indicate for reach - pools and riffles.

Comments _____

Pool / Current
Maximum 12
10

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). NO RIFFLE (metric=0)

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
<input checked="" type="checkbox"/> BEST AREAS > 10cm [2]	<input type="checkbox"/> MAXIMUM > 50cm [2]	<input checked="" type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2]	<input checked="" type="checkbox"/> NONE [2]
<input type="checkbox"/> BEST AREAS 5-10cm [1]	<input checked="" type="checkbox"/> MAXIMUM < 50cm [1]	<input type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1]	<input type="checkbox"/> LOW [1]
<input type="checkbox"/> BEST AREAS < 5cm (metric=0)		<input type="checkbox"/> UNSTABLE (e.g., Fine Gravel, Sand) [0]	<input type="checkbox"/> MODERATE [0]
			<input type="checkbox"/> EXTENSIVE [-1]

Comments _____

Riffle / Run
Maximum 6
1

6) **GRADIENT** (3.86 ft/mi) VERY LOW - LOW [2-4] MODERATE [6-10] HIGH - VERY HIGH [10-6]

DRAINAGE AREA (537 mi²)

% POOL: ? % GLIDE: ?

% RUN: ? % RIFFLE: ?

Gradient Maximum 10
8

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

CLARITY

- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/ CTB

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CANOPY

- > 85% - OPEN
- 55% - 85%
- 30% - 55%
- 10% - 30%
- < 10% - CLOSED

CLARITY

- 1st --sample pass-- 2nd
- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/ CTB

SECCHI DEPTH

- meters
- 1st _____ cm
- 2nd _____ cm

BI/AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

Circle some & COMMENT

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

EJ ISSUES

- width
- depth
- max. depth
- bankfull width
- bankfull x depth
- W/D ratio
- bankfull max. depth
- floodprone x² width
- entrench. ratio

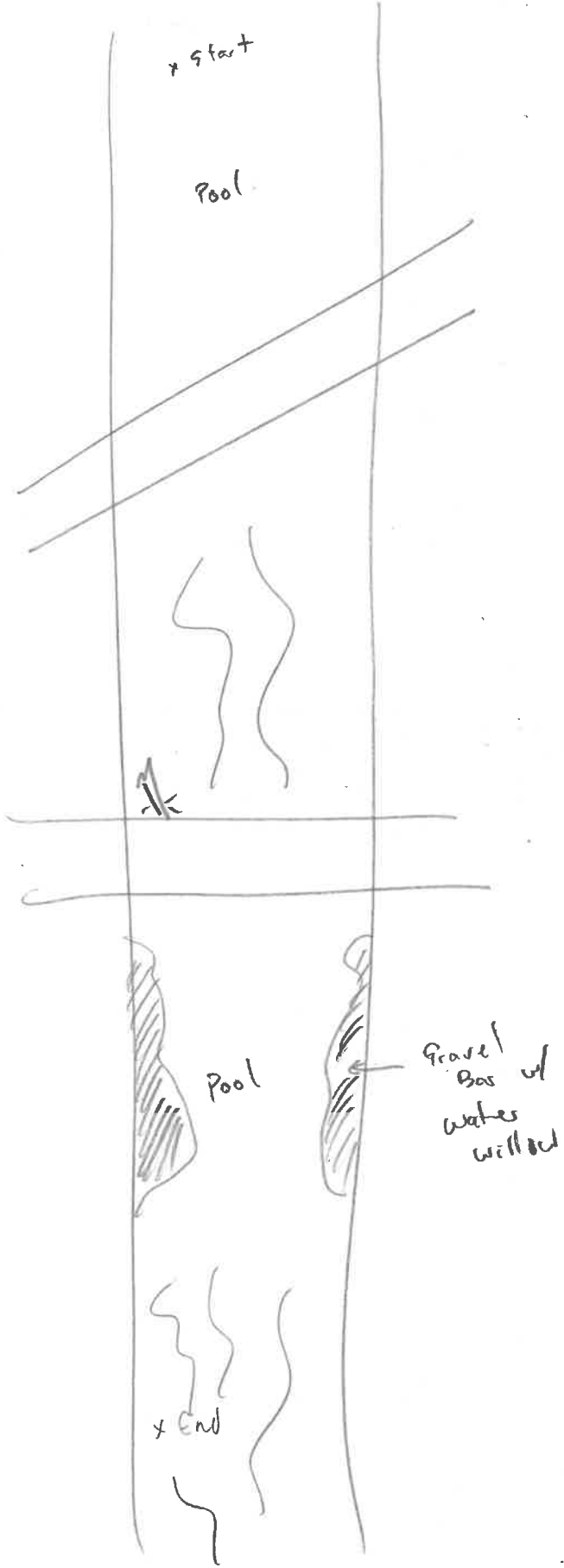
FJ MEASUREMENTS

Legacy Tree:

CJ RECREATION

- AREA
- DEPTH
- POOL: >100R2 >3ft

Stream Drawing:



Stream & Location: Olenburg River dst. 5th Ave. east. 3rd Ave. RM: 1.8 Date: 8/13/2022

River Code: 02-400 STORET #: _____ Scorer's Full Name & Affiliation: MBI-Mas

Lat./Long.: 39 183 Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES		POOL RIFFLE		OTHER TYPES		POOL RIFFLE		ORIGIN		QUALITY	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

NUMBER OF BEST TYPES: 4 or more [2] 3 or less [0]

Comments _____

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

<u>0</u>	<u>2</u>	<u>0</u>	<u>0</u>	AMOUNT
<input checked="" type="checkbox"/> UNDERCUT BANKS [1]	<input checked="" type="checkbox"/> POOLS > 70cm [2]	<input type="checkbox"/> OXBOWS, BACKWATERS [1]	<input type="checkbox"/> AQUATIC MACROPHYTES [1]	Check ONE (Or 2 & average)
<input checked="" type="checkbox"/> OVERHANGING VEGETATION [1]	<input type="checkbox"/> ROOTWADS [1]	<input type="checkbox"/> LOGS OR WOODY DEBRIS [1]	<input type="checkbox"/> NEARLY ABSENT <5% [1]	<input type="checkbox"/> EXTENSIVE >75% [11]
<input checked="" type="checkbox"/> SHALLOWS (IN SLOW WATER) [1]	<input checked="" type="checkbox"/> BOULDERS [1]		<input type="checkbox"/> MODERATE 25-75% [7]	<input type="checkbox"/> SPARSE 5-<25% [3]
<input checked="" type="checkbox"/> ROOTMATS [1]			<input type="checkbox"/> MODERATE -1 [1]	<input type="checkbox"/> NONE [1]

Comments _____

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

<input checked="" type="checkbox"/> HIGH [4]	<input checked="" type="checkbox"/> EXCELLENT [7]	<input type="checkbox"/> NONE [6]	<input checked="" type="checkbox"/> HIGH [3]
<input type="checkbox"/> MODERATE [3]	<input type="checkbox"/> GOOD [5]	<input checked="" type="checkbox"/> RECOVERED [4]	<input checked="" type="checkbox"/> MODERATE [2]
<input type="checkbox"/> LOW [2]	<input type="checkbox"/> FAIR [3]	<input type="checkbox"/> RECOVERING [3]	<input type="checkbox"/> LOW [1]
<input type="checkbox"/> NONE [1]	<input type="checkbox"/> POOR [1]	<input type="checkbox"/> RECENT OR NO RECOVERY [1]	

Comments _____

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

<input checked="" type="checkbox"/> NONE / LITTLE [3]	<input type="checkbox"/> WIDE > 50m [4]	<input type="checkbox"/> FOREST, SWAMP [3]	<input type="checkbox"/> CONSERVATION TILLAGE [1]
<input checked="" type="checkbox"/> MODERATE [2]	<input checked="" type="checkbox"/> MODERATE 10-50m [3]	<input type="checkbox"/> SHRUB OR OLD FIELD [2]	<input checked="" type="checkbox"/> URBAN OR INDUSTRIAL [0]
<input type="checkbox"/> HEAVY / SEVERE [1]	<input checked="" type="checkbox"/> NARROW 5-10m [2]	<input type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1]	<input type="checkbox"/> MINING / CONSTRUCTION [0]
	<input type="checkbox"/> VERY NARROW < 5m [1]	<input type="checkbox"/> FENCED PASTURE [1]	
	<input type="checkbox"/> NONE [0]	<input type="checkbox"/> OPEN PASTURE, ROWCROP [0]	

Comments _____

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

<input checked="" type="checkbox"/> > 1m [6]	<input type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2]	<input type="checkbox"/> TORRENTIAL [-1]	<input checked="" type="checkbox"/> SLOW [1]
<input type="checkbox"/> 0.7-1m [4]	<input checked="" type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1]	<input checked="" type="checkbox"/> VERY FAST [1]	<input type="checkbox"/> INTERSTITIAL [-1]
<input type="checkbox"/> 0.4-0.7m [2]	<input type="checkbox"/> POOL WIDTH < RIFFLE WIDTH [0]	<input checked="" type="checkbox"/> FAST [1]	<input type="checkbox"/> INTERMITTENT [-2]
<input type="checkbox"/> 0.2-0.4m [1]		<input checked="" type="checkbox"/> MODERATE [1]	<input checked="" type="checkbox"/> EDDIES [1]
<input type="checkbox"/> < 0.2m [0]			

Comments _____

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: NO RIFFLE [metric=0]

<input checked="" type="checkbox"/> BEST AREAS > 10cm [2]	<input checked="" type="checkbox"/> MAXIMUM > 50cm [2]	<input checked="" type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2]	<input checked="" type="checkbox"/> NONE [2]
<input type="checkbox"/> BEST AREAS 5-10cm [1]	<input type="checkbox"/> MAXIMUM < 50cm [1]	<input checked="" type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1]	<input type="checkbox"/> LOW [1]
<input type="checkbox"/> BEST AREAS < 5cm [metric=0]		<input type="checkbox"/> UNSTABLE (e.g., Fine Gravel, Sand) [0]	<input type="checkbox"/> MODERATE [0]
			<input checked="" type="checkbox"/> EXTENSIVE [-1]

Comments _____

6] GRADIENT (4.34 ft/ml) VERY LOW - LOW [2-4] MODERATE [6-10] HIGH - VERY HIGH [10-6]

DRAINAGE AREA (537 mi²)

%POOL: %GLIDE:

%RUN: %RIFFLE:

Comments _____

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- <20 cm
- 20-40 cm
- 40-70 cm
- >70 cm/CTB

SECCHI DEPTH

- meters
- 1st cm
- 2nd cm

CANOPY

- >85% - OPEN
- 55%-85%
- 30%-55%
- 10%-30%
- <10% - CLOSED

CJ RECREATION

- POOL: <100R2
- >3ft

BI/AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

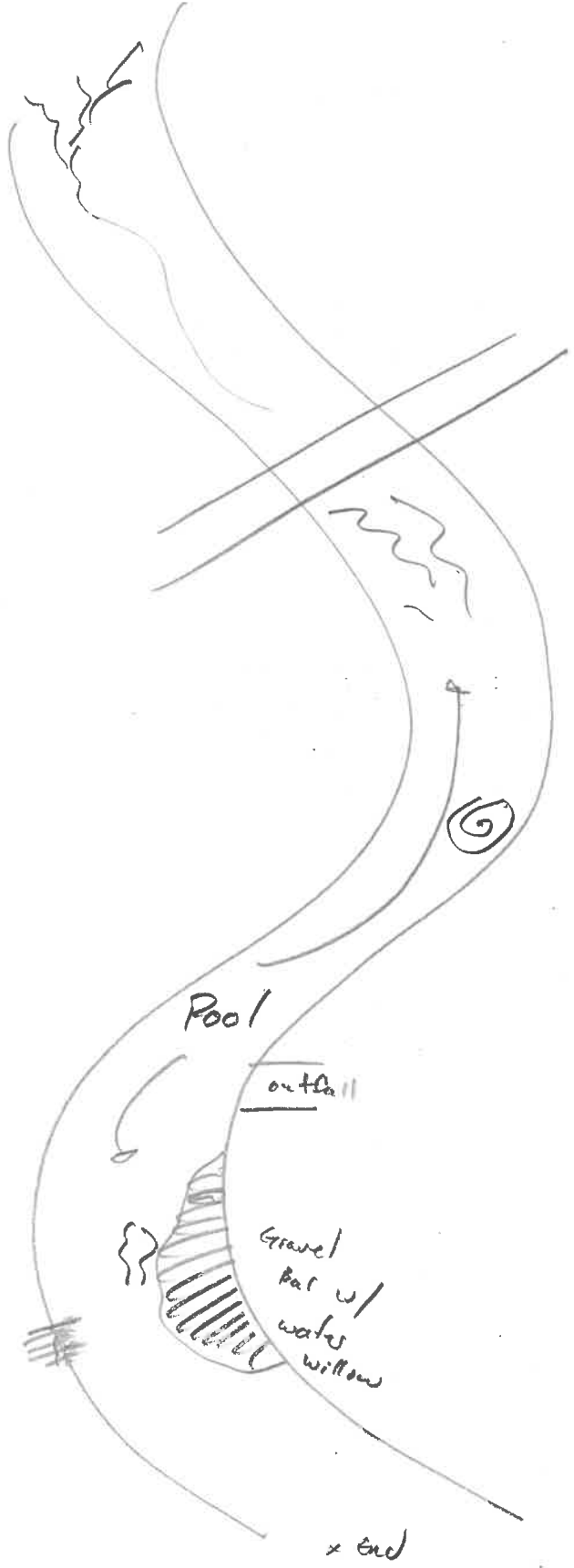
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- width
- depth
- max. depth
- bankfull width
- bankfull x depth
- W/D ratio
- bankfull max. depth
- floodprone x² width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Ontonagon River just. 1-670 bridge RM: 0.2 Date: 8/19/2022
 OLNO4 Scorers Full Name & Affiliation: MBI - MAS
 River Code: 02-400- STORET #: _____ Lat./Long.: 39 183 Office verified location
(NAD 83 - decimal)

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES		POOL RIFFLE		OTHER TYPES		POOL RIFFLE		ORIGIN		QUALITY	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Check ONE (Or 2 & average)

NUMBER OF BEST TYPES: 4 or more [2] 3 or less [0] (Score natural substrates; ignore sludge from point-sources)

Comments _____

Substrate Maximum 20 **18**

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

<u>0</u> UNDERCUT BANKS [1]	<u>1</u> POOLS > 70cm [2]	<u>3</u> OXBOWS, BACKWATERS [1]
<u>0</u> OVERHANGING VEGETATION [1]	<u>0</u> ROOTWADS [1]	<u>0</u> AQUATIC MACROPHYTES [1]
<u>3</u> SHALLOWS (IN SLOW WATER) [1]	<u>3</u> BOULDERS [1]	<u>1</u> LOGS OR WOODY DEBRIS [1]
<u>6</u> ROOTMATS [1]		

Check ONE (Or 2 & average)

Comments _____

Amount Maximum 20 **13**

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
<input type="checkbox"/> HIGH [4]	<input type="checkbox"/> EXCELLENT [7]	<input type="checkbox"/> NONE [6]	<input checked="" type="checkbox"/> HIGH [3]
<input type="checkbox"/> MODERATE [3]	<input checked="" type="checkbox"/> GOOD [5]	<input checked="" type="checkbox"/> RECOVERED [4]	<input type="checkbox"/> MODERATE [2]
<input checked="" type="checkbox"/> LOW [2]	<input type="checkbox"/> FAIR [3]	<input type="checkbox"/> RECOVERING [3]	<input type="checkbox"/> LOW [1]
<input type="checkbox"/> NONE [1]	<input type="checkbox"/> POOR [1]	<input type="checkbox"/> RECENT OR NO RECOVERY [1]	

Comments _____

Channel Maximum 20 **14**

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION	RIPARIAN WIDTH	FLOOD PLAIN QUALITY
<input checked="" type="checkbox"/> NONE / LITTLE [3]	<input type="checkbox"/> WIDE > 50m [4]	<input type="checkbox"/> FOREST, SWAMP [3]
<input type="checkbox"/> MODERATE [2]	<input type="checkbox"/> MODERATE 10-50m [3]	<input type="checkbox"/> SHRUB OR OLD FIELD [2]
<input type="checkbox"/> HEAVY / SEVERE [1]	<input type="checkbox"/> NARROW 5-10m [2]	<input checked="" type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1]
	<input checked="" type="checkbox"/> VERY NARROW < 5m [1]	<input type="checkbox"/> FENCED PASTURE [1]
	<input type="checkbox"/> NONE [0]	<input type="checkbox"/> OPEN PASTURE, ROWCROP [0]

Indicate predominant land use(s) past 100m riparian.

Comments _____

Riparian Maximum 10 **4.5**

5) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH	CHANNEL WIDTH	CURRENT VELOCITY	Recreation Potential
Check ONE (ONLY!)	Check ONE (Or 2 & average)	Check ALL that apply	Primary Contact
<input checked="" type="checkbox"/> > 1m [6]	<input type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2]	<input type="checkbox"/> TORRENTIAL [-1]	Secondary Contact
<input type="checkbox"/> 0.7-1m [4]	<input type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1]	<input checked="" type="checkbox"/> VERY FAST [1]	(circle one and comment on back)
<input type="checkbox"/> 0.4-0.7m [2]	<input checked="" type="checkbox"/> POOL WIDTH < RIFFLE WIDTH [0]	<input type="checkbox"/> INTERSTITIAL [-1]	
<input type="checkbox"/> 0.2-0.4m [1]		<input checked="" type="checkbox"/> FAST [1]	
<input type="checkbox"/> < 0.2m [0]		<input checked="" type="checkbox"/> MODERATE [1]	
		<input checked="" type="checkbox"/> INTERMITTENT [-2]	
		<input checked="" type="checkbox"/> EDDIES [1]	

Indicate for reach - pools and riffles.

Comments _____

Pool / Current Maximum 12 **11**

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
<input checked="" type="checkbox"/> BEST AREAS > 10cm [2]	<input checked="" type="checkbox"/> MAXIMUM > 50cm [2]	<input checked="" type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2]	<input checked="" type="checkbox"/> NONE [2]
<input type="checkbox"/> BEST AREAS 5-10cm [1]	<input type="checkbox"/> MAXIMUM < 50cm [1]	<input type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1]	<input type="checkbox"/> LOW [1]
<input type="checkbox"/> BEST AREAS < 5cm [metric=0]		<input type="checkbox"/> UNSTABLE (e.g., Fine Gravel, Sand) [0]	<input type="checkbox"/> MODERATE [0]
			<input type="checkbox"/> EXTENSIVE [-1]

Comments _____

Riffle / Run Maximum 8 **8**

6) GRADIENT (4.3 ft/mi) VERY LOW - LOW [2-4] MODERATE [6-10] HIGH - VERY HIGH [10-6]

DRAINAGE AREA (543 mi²)

%POOL: %GLIDE:
 %RUN: %RIFFLE:

Comments _____

Gradient Maximum 10 **10**

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- 1st-sample pass--2nd
- HIGH
- UP
- NORMAL
- LOW
- DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/CTB
- SECCHI DEPTH

300 meters

CANOPY

- > 85%- OPEN
- 55%-85%
- 30%-55%
- 10%-30%
- <10%- CLOSED

CJ RECREATION

- AREA DEPTH
- POOL: >100ft? >3ft

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMOURED / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

Circle some & COMMENT

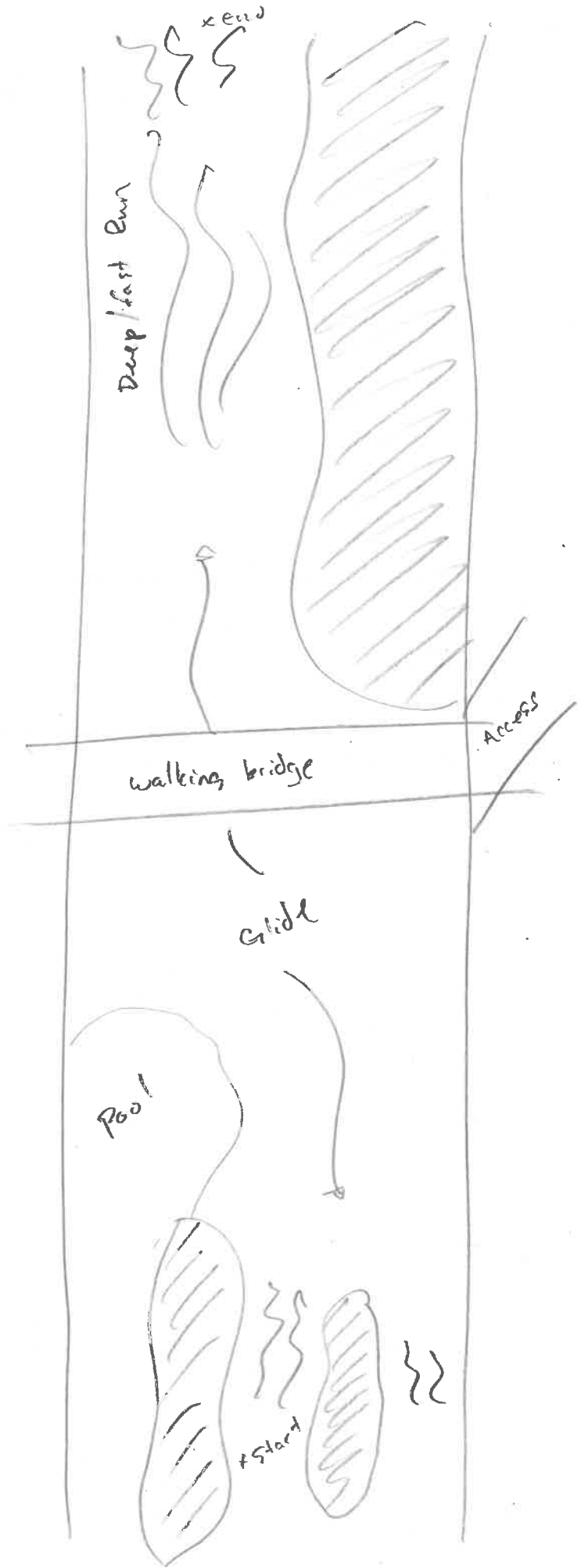
EJ ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio
- Legacy Tree:

Stream Drawing:



Stream & Location: Orientancy River Dist OH-750 RM: 14.9 Date: 7/15/2022
 OLNOS

River Code: 02-400- STORET #: _____ Lat./Long: 40 183 Office verified location
 Scorers Full Name & Affiliation: MAS -> MBI

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES		POOL RIFFLE	OTHER TYPES		POOL RIFFLE	ORIGIN		QUALITY	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Check ONE (Or 2 & average)

NUMBER OF BEST TYPES: 4 or more [2] 3 or less [0]

Comments _____

Substrate Maximum 20 14

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

<u>0</u> UNDERCUT BANKS [1]	<u>3</u> POOLS > 70cm [2]	<u>2</u> OXBOWS, BACKWATERS [1]	AMOUNT	
<u>1</u> OVERHANGING VEGETATION [1]	<u>2</u> ROOTWADS [1]	<u>3</u> AQUATIC MACROPHYTES [1]	Check ONE (Or 2 & average)	
<u>3</u> SHALLOWS (IN SLOW WATER) [1]	<u>3</u> BOULDERS [1]	<u>1</u> LOGS OR WOODY DEBRIS [1]	<input type="checkbox"/>	EXTENSIVE >75% [11]
<u>3</u> ROOTMATS [1]			<input checked="" type="checkbox"/>	MODERATE 25-75% [7]
			<input type="checkbox"/>	SPARSE 5-<25% [3]
			<input type="checkbox"/>	NEARLY ABSENT <5% [1]

Comments _____

Cover Maximum 20 17

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
<input type="checkbox"/> HIGH [4]	<input checked="" type="checkbox"/> EXCELLENT [7]	<input type="checkbox"/> NONE [6]	<input checked="" type="checkbox"/> HIGH [3]
<input type="checkbox"/> MODERATE [3]	<input type="checkbox"/> GOOD [5]	<input checked="" type="checkbox"/> RECOVERED [4]	<input type="checkbox"/> MODERATE [2]
<input type="checkbox"/> LOW [2]	<input type="checkbox"/> FAIR [3]	<input type="checkbox"/> RECOVERING [3]	<input type="checkbox"/> LOW [1]
<input type="checkbox"/> NONE [1]	<input type="checkbox"/> POOR [1]	<input type="checkbox"/> RECENT OR NO RECOVERY [1]	

Comments _____

Channel Maximum 20 17

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

EROSION		RIPARIAN WIDTH		FLOOD PLAIN QUALITY	
<input type="checkbox"/> NONE / LITTLE [3]	<input type="checkbox"/> MODERATE [2]	<input type="checkbox"/> WIDE > 50m [4]	<input type="checkbox"/> MODERATE 10-50m [3]	<input type="checkbox"/> FOREST, SWAMP [3]	<input type="checkbox"/> CONSERVATION TILLAGE [1]
<input checked="" type="checkbox"/> MODERATE [2]	<input type="checkbox"/> HEAVY / SEVERE [1]	<input checked="" type="checkbox"/> NARROW 5-10m [2]	<input checked="" type="checkbox"/> VERY NARROW < 5m [1]	<input checked="" type="checkbox"/> SHRUB OR OLD FIELD [2]	<input type="checkbox"/> URBAN OR INDUSTRIAL [0]
		<input type="checkbox"/> NONE [0]		<input checked="" type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1]	<input type="checkbox"/> MINING / CONSTRUCTION [0]
				<input type="checkbox"/> FENCED PASTURE [1]	
				<input type="checkbox"/> OPEN PASTURE, ROWCROP [0]	

Comments _____

Indicate predominant land use(s) past 100m riparian. Riparian Maximum 10 4.5

5) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH	CHANNEL WIDTH	CURRENT VELOCITY	Recreation Potential
Check ONE (ONLY!)	Check ONE (Or 2 & average)	Check ALL that apply	Primary Contact
<input checked="" type="checkbox"/> > 1m [6]	<input type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2]	<input type="checkbox"/> TORRENTIAL [-1]	Secondary Contact
<input type="checkbox"/> 0.7-<1m [4]	<input checked="" type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1]	<input checked="" type="checkbox"/> VERY FAST [1]	(circle one and comment on back)
<input type="checkbox"/> 0.4-<0.7m [2]	<input type="checkbox"/> POOL WIDTH < RIFFLE WIDTH [0]	<input checked="" type="checkbox"/> FAST [1]	
<input type="checkbox"/> 0.2-<0.4m [1]		<input type="checkbox"/> MODERATE [1]	
<input type="checkbox"/> < 0.2m [0]		<input checked="" type="checkbox"/> INTERSTITIAL [-1]	
		<input checked="" type="checkbox"/> INTERMITTENT [-2]	
		<input checked="" type="checkbox"/> MODERATE [1]	
		<input checked="" type="checkbox"/> EDDIES [1]	

Comments _____

Pool / Current Maximum 12 11

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average).

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
<input checked="" type="checkbox"/> BEST AREAS > 10cm [2]	<input checked="" type="checkbox"/> MAXIMUM > 50cm [2]	<input checked="" type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2]	<input type="checkbox"/> NONE [2]
<input type="checkbox"/> BEST AREAS 5-10cm [1]	<input type="checkbox"/> MAXIMUM < 50cm [1]	<input checked="" type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1]	<input checked="" type="checkbox"/> LOW [1]
<input type="checkbox"/> BEST AREAS < 5cm [metric=0]		<input type="checkbox"/> UNSTABLE (e.g., Fine Gravel, Sand) [0]	<input type="checkbox"/> MODERATE [0]
			<input type="checkbox"/> EXTENSIVE [-1]

Comments _____

Riffle / Run Maximum 8 6.5

6) GRADIENT (13.9 ft/mi) VERY LOW - LOW [2-4] MODERATE [6-10] HIGH - VERY HIGH [10-6]

DRAINAGE AREA (482 mi²)

%POOL: ? %GLIDE: ?

%RUN: ? %RIFFLE: ?

Gradient Maximum 10 8

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- I.L. LINE
- OTHER

STAGE

- 1st-sample pass-- 2nd
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

DISTANCE

- <0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- <20 cm
- 20-40 cm
- 40-70 cm
- >70 cm/CTB
- SECCHI DEPTH

meters

CANOPY

- > 85% - OPEN
- 55% - 85%
- 30% - 55%
- 10% - 30%
- <10% - CLOSED

B/AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMOURD / SLUMPS
- ISLANDS / SCOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

Circle some & COMMENT

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

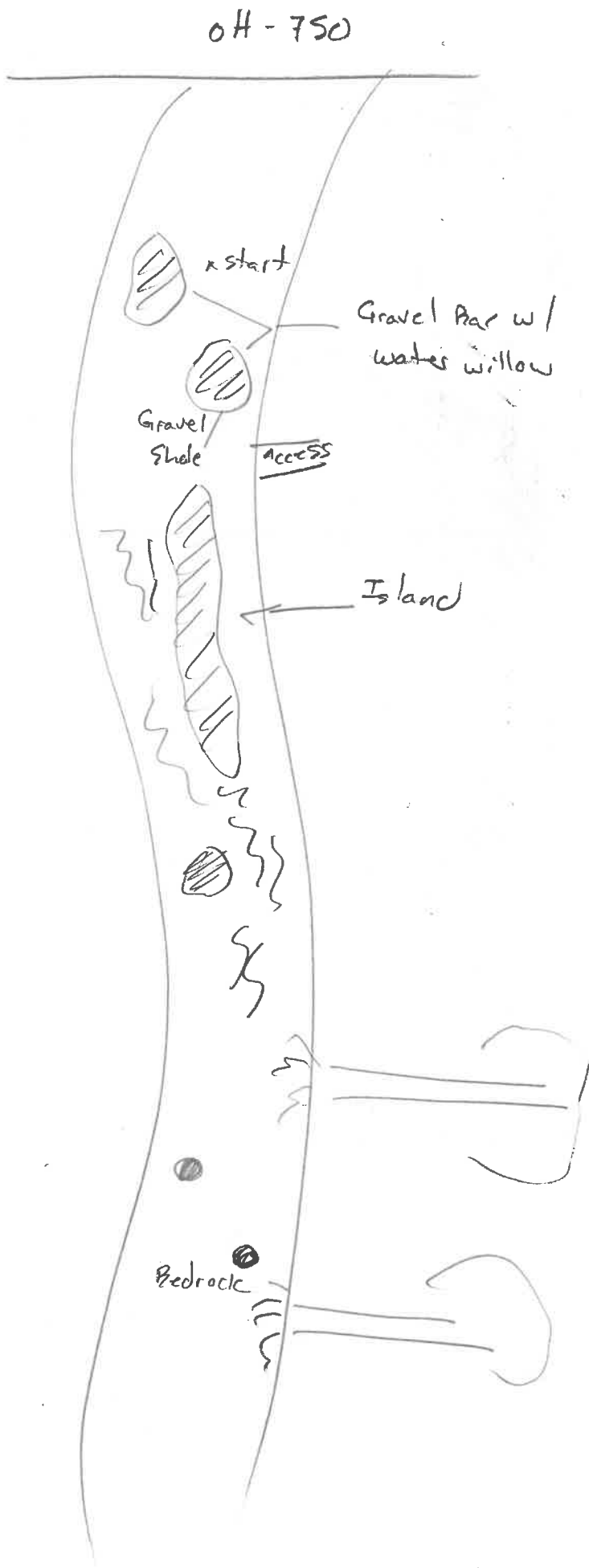
E/I ISSUES

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

CJ RECREATION AREA DEPTH
 POOL: >100R2 >3ft

Stream Drawing:



Stream & Location: Ontonagon River Dist Ontonagon WEF RM: 12.9 Date: 8/19/2022

OLNo 7 Scorers Full Name & Affiliation: HBI - MAS
 River Code: 02 - 400 - STORET #: Lat./Long.: 40 183 Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

<p>BEST TYPES</p> <input type="checkbox"/> BLDG / SLABS [10] <input type="checkbox"/> BOULDER [9] <input checked="" type="checkbox"/> COBBLE [8] <input checked="" type="checkbox"/> GRAVEL [7] <input type="checkbox"/> SAND [6] <input type="checkbox"/> BEDROCK [5]	<p>POOL RIFFLE</p> <p><u>X</u> <u>Y</u> <u>X</u> <u>Y</u> <u>X</u> <u>Y</u> <u>X</u> <u>Y</u></p>	<p>OTHER TYPES</p> <input type="checkbox"/> HARDPAN [4] <input type="checkbox"/> DETRITUS [3] <input type="checkbox"/> MUCK [2] <input type="checkbox"/> SILT [2] <input type="checkbox"/> ARTIFICIAL [0]	<p>POOL RIFFLE</p> <p><u>X</u> <u>Y</u> <u>X</u> <u>Y</u> <u>X</u> <u>Y</u></p>	<p>ORIGIN</p> <input checked="" type="checkbox"/> LIMESTONE [1] <input type="checkbox"/> TILLS [1] <input type="checkbox"/> WETLANDS [0] <input type="checkbox"/> HARDPAN [0] <input type="checkbox"/> SANDSTONE [0] <input type="checkbox"/> RIP/RAP [0] <input type="checkbox"/> LACUSTURINE [0] <input checked="" type="checkbox"/> SHALE [-1] <input type="checkbox"/> COAL FINES [-2]	<p>QUALITY</p> <input type="checkbox"/> HEAVY [-2] <input checked="" type="checkbox"/> MODERATE [-1] <input type="checkbox"/> NORMAL [0] <input type="checkbox"/> FREE [1] <input type="checkbox"/> EXTENSIVE [-2] <input checked="" type="checkbox"/> MODERATE [-1] <input checked="" type="checkbox"/> NORMAL [0] <input type="checkbox"/> NONE [1]
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Check ONE (Or 2 & average)

SILT EMBEDDEDNESS

NUMBER OF BEST TYPES: 4 or more [2] sludge from point-sources
 3 or less [0]

Comments Substrate Maximum 20 16

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

<p><u>1</u> UNDERCUT BANKS [1] <u>1</u> OVERHANGING VEGETATION [1] <u>3</u> SHALLOWS (IN SLOW WATER) [1] <u>2</u> ROOTMATS [1]</p>	<p><u>2</u> POOLS > 70cm [2] <u>2</u> ROOTWADS [1] <u>2</u> BOULDERS [1]</p>	<p><u>0</u> OXBOWS, BACKWATERS [1] <u>0</u> AQUATIC MACROPHYTES [1] <u>2</u> LOGS OR WOODY DEBRIS [1]</p>
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AMOUNT Check ONE (Or 2 & average)

EXTENSIVE >75% [11]
 MODERATE 25-75% [7]
 SPARSE 5-<25% [3]
 NEARLY ABSENT <5% [1]

Comments Cover Maximum 20 16

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

<p>SINUOSITY</p> <input type="checkbox"/> HIGH [4] <input checked="" type="checkbox"/> MODERATE [3] <input type="checkbox"/> LOW [2] <input type="checkbox"/> NONE [1]	<p>DEVELOPMENT</p> <input type="checkbox"/> EXCELLENT [7] <input checked="" type="checkbox"/> GOOD [5] <input type="checkbox"/> FAIR [3] <input type="checkbox"/> POOR [1]	<p>CHANNELIZATION</p> <input type="checkbox"/> NONE [6] <input checked="" type="checkbox"/> RECOVERED [4] <input type="checkbox"/> RECOVERING [3] <input type="checkbox"/> RECENT OR NO RECOVERY [1]	<p>STABILITY</p> <input checked="" type="checkbox"/> HIGH [3] <input checked="" type="checkbox"/> MODERATE [2] <input type="checkbox"/> LOW [1]
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Comments Channel Maximum 20 14.5

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

<p>EROSION</p> <input type="checkbox"/> NONE / LITTLE [3] <input checked="" type="checkbox"/> MODERATE [2] <input type="checkbox"/> HEAVY / SEVERE [1]	<p>RIPARIAN WIDTH</p> <input checked="" type="checkbox"/> WIDE > 50m [4] <input type="checkbox"/> MODERATE 10-50m [3] <input type="checkbox"/> NARROW 5-10m [2] <input checked="" type="checkbox"/> VERY NARROW < 5m [1] <input type="checkbox"/> NONE [0]	<p>FLOOD PLAIN QUALITY</p> <input checked="" type="checkbox"/> FOREST, SWAMP [3] <input type="checkbox"/> SHRUB OR OLD FIELD [2] <input checked="" type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1] <input type="checkbox"/> FENCED PASTURE [1] <input type="checkbox"/> OPEN PASTURE, ROWCROP [0]	<p>CONSERVATION TILLAGE</p> <input type="checkbox"/> URBAN OR INDUSTRIAL [0] <input type="checkbox"/> MINING / CONSTRUCTION [0]
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Indicate predominant land use(s) past 100m riparian. Riparian Maximum 10 7

Comments

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

<p>MAXIMUM DEPTH Check ONE (ONLY!)</p> <input type="checkbox"/> > 1m [6] <input checked="" type="checkbox"/> 0.7-1m [4] <input type="checkbox"/> 0.4-0.7m [2] <input type="checkbox"/> 0.2-0.4m [1] <input type="checkbox"/> < 0.2m [0]	<p>CHANNEL WIDTH Check ONE (Or 2 & average)</p> <input type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2] <input checked="" type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1] <input type="checkbox"/> POOL WIDTH < RIFFLE WIDTH [0]	<p>CURRENT VELOCITY Check ALL that apply</p> <input type="checkbox"/> TORRENTIAL [-1] <input type="checkbox"/> VERY FAST [1] <input checked="" type="checkbox"/> FAST [1] <input checked="" type="checkbox"/> MODERATE [1]	<p>Indicate for reach - pools and riffles.</p> <input checked="" type="checkbox"/> SLOW [1] <input type="checkbox"/> INTERSTITIAL [-1] <input type="checkbox"/> INTERMITTENT [-2] <input type="checkbox"/> EDDIES [1]
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Recreation Potential
 Primary Contact
 Secondary Contact (circle one and comment on back)

Comments Pool / Current Maximum 12 8

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: NO RIFFLE [metric=0]

Check ONE (Or 2 & average).

<p>RIFFLE DEPTH</p> <input checked="" type="checkbox"/> BEST AREAS > 10cm [2] <input type="checkbox"/> BEST AREAS 5-10cm [1] <input type="checkbox"/> BEST AREAS < 5cm [metric=0]	<p>RUN DEPTH</p> <input checked="" type="checkbox"/> MAXIMUM > 50cm [2] <input type="checkbox"/> MAXIMUM < 50cm [1]	<p>RIFFLE / RUN SUBSTRATE</p> <input type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2] <input checked="" type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1] <input type="checkbox"/> UNSTABLE (e.g., Fine Gravel, Sand) [0]	<p>RIFFLE / RUN EMBEDDEDNESS</p> <input type="checkbox"/> NONE [2] <input type="checkbox"/> LOW [1] <input checked="" type="checkbox"/> MODERATE [0] <input type="checkbox"/> EXTENSIVE [-1]
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Comments Riffle / Run Maximum 8 5

6] GRADIENT (5.78 ft/mi) VERY LOW - LOW [2-4]
 MODERATE [6-10]
 HIGH - VERY HIGH [10-6]

DRAINAGE AREA (489 mi²)

%POOL: ? %GLIDE: ?
 %RUN: ? %RIFFLE: ?

Comments Gradient Maximum 10 10

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD
 BOAT
 WADE
 L. LINE
 OTHER

DISTANCE
 0.5 Km
 0.2 Km
 0.15 Km
 0.12 Km
 OTHER

STAGE
 1st-sample pass-- 2nd
 HIGH
 UP
 NORMAL
 LOW
 DRY

CLARITY
 1st --sample pass-- 2nd
 < 20 cm
 20-40 cm
 40-70 cm
 > 70 cm/ CTB
 SECCHI DEPTH

CANOPY
 meters
 > 85% - OPEN
 55% - < 85%
 30% - < 55%
 10% - < 30%
 < 10% - CLOSED

B/AESTHETICS
 NUISANCE ALGAE
 INVASIVE MACROPHYTES
 EXCESS TURBIDITY
 DISCOLORATION
 FOAM / SCUM
 OIL SHEEN
 TRASH / LITTER
 NUISANCE ODOR
 SLUDGE DEPOSITS
 CSOs/SSOs/OUTFALLS

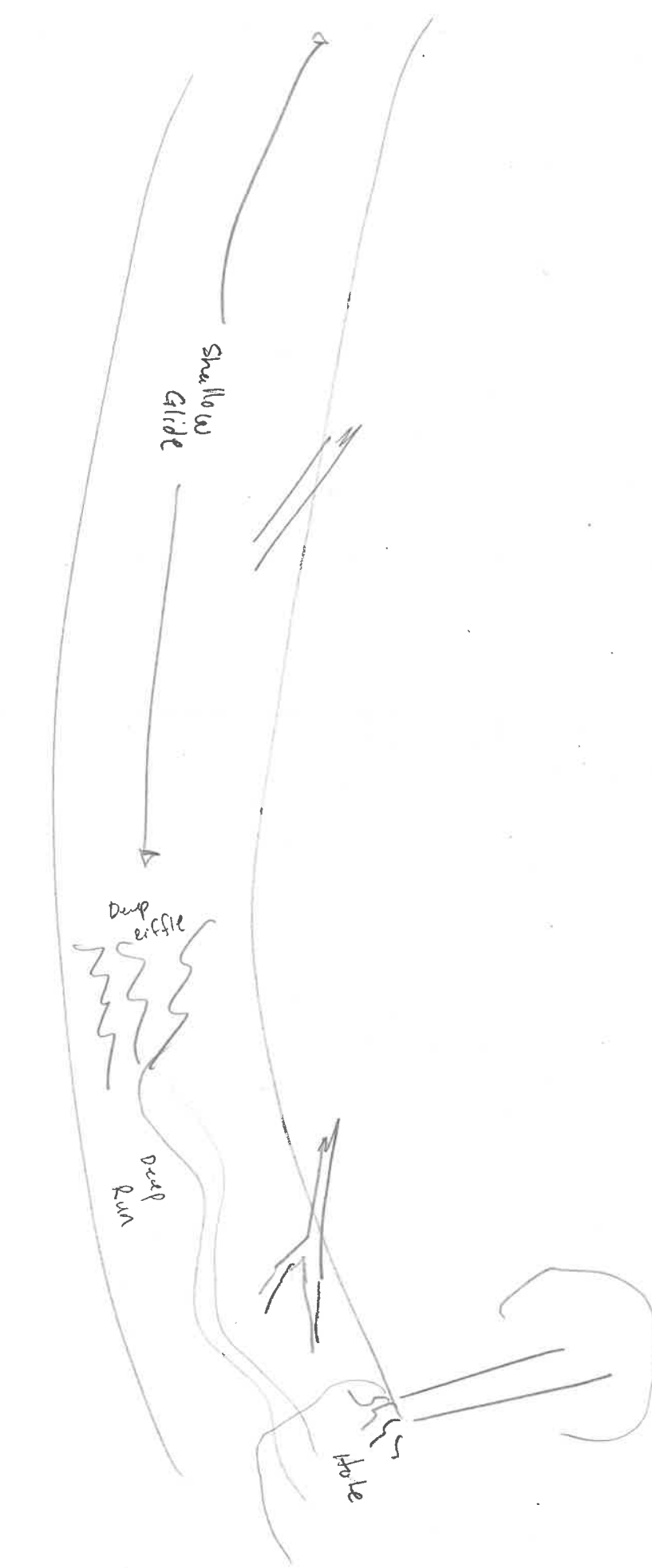
DJ MAINTENANCE
 PUBLIC / PRIVATE / BOTH / NA
 ACTIVE / HISTORIC / BOTH / NA
 YOUNG-SUCCESSION-OLD
 SPRAY / SNAG / REMOVED
 MODIFIED / DIPPED OUT / NA
 LEVEED / ONE SIDED
 RELOCATED / CUTOFFS
 MOVING-BEDLOAD-STABLE
 ARMoured / SLUMPS
 ISLANDS / SCOURED
 IMPOUNDED / DESICCATED
 FLOOD CONTROL / DRAINAGE

E/I ISSUES
 WWTP / CSO / NPDES / INDUSTRY
 HARDENED / URBAN / DIRT&GRIME
 CONTAMINATED / LANDFILL
 BMPs-CONSTRUCTION-SEDIMENT
 LOGGING / IRRIGATION / COOLING
 BANK / EROSION / SURFACE
 FALSE BANK / MANURE / LAGOON
 WASH H₂O / TILE / H₂O TABLE
 ACID / MINE / QUARRY / FLOW
 NATURAL / WETLAND / STAGNANT
 PARK / GOLF / LAWN / HOME
 ATMOSPHERE / DATA PAUCITY

F/J MEASUREMENTS
 \bar{x} width
 \bar{x} depth
 max. depth
 \bar{x} bankfull width
 bankfull \bar{x} depth
 W/D ratio
 bankfull max. depth
 floodprone \bar{x}^2 width
 entrench. ratio
 Legacy Tree:

C/J RECREATION
 AREA DEPTH
 POOL: >100ft² >3ft

Stream Drawing:



The majority of the site is a shallow glide that sporadically yields shelves

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

1st sample pass-- 2nd

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%- CLOSED

CJ RECREATION

AREA DEPTH
POOL: >100ft² >3ft

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

Circle some & COMMENT

EJ ISSUES

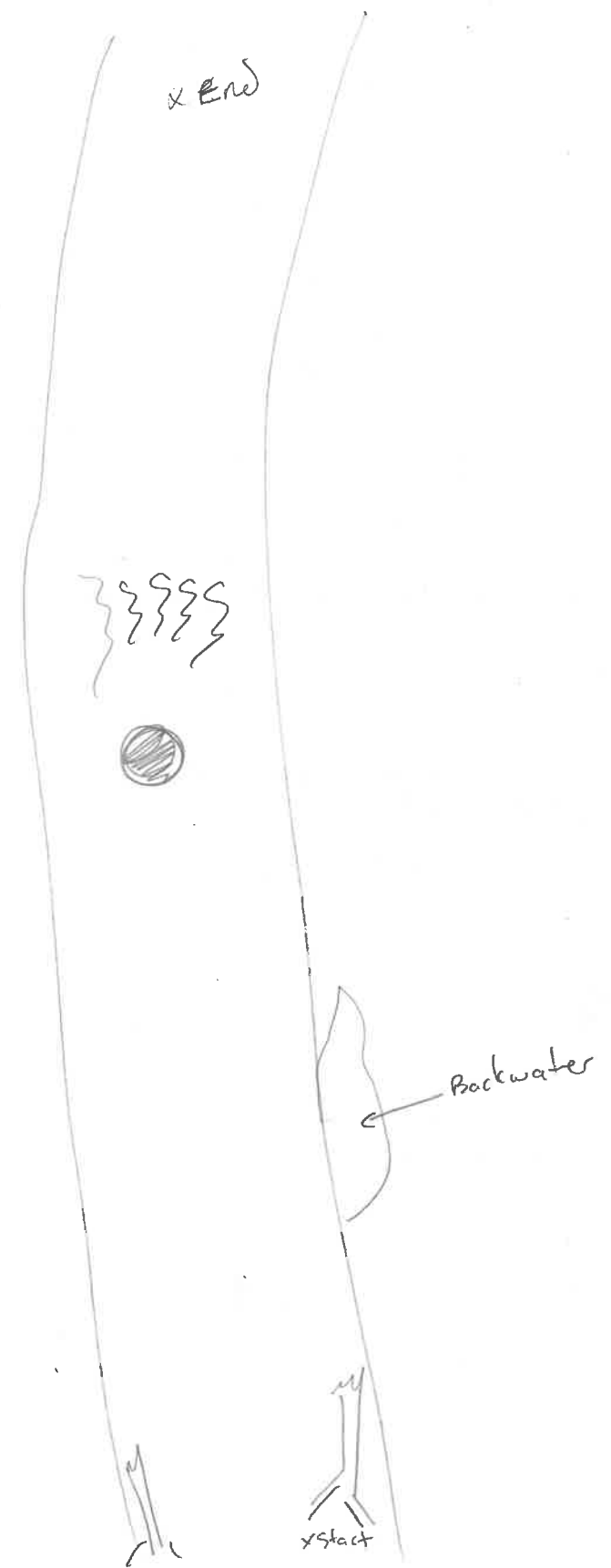
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Olentangy River Dist Broad Meadows Dam RM: 8.5 Date: 8/30/2022

River Code: 02-400 STORET #: Lat./Long.: 40.183 Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Substrate assessment table with categories: BEST TYPES, OTHER TYPES, POOL RIFFLE, ORIGIN, and QUALITY. Includes checkboxes for various substrate types and a score box for Quality (18).

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts

Instream Cover assessment table with categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes checkboxes and a score box for Amount (14).

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel Morphology assessment table with categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes checkboxes and a score box for Channel Maximum (14).

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Bank Erosion and Riparian Zone assessment table with categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes checkboxes and a score box for Riparian Maximum (6.5).

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

Pool / Glide and Riffle / Run Quality assessment table with categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY, Recreation Potential. Includes checkboxes and a score box for Pool / Current Maximum (11).

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). NO RIFFLE [metric=0]

Riffle assessment table with categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes checkboxes and a score box for Riffle / Run Maximum (8).

6] GRADIENT (2.91 ft/mi) DRAINAGE AREA (510 mi^2) %POOL: %GLIDE: %RUN: %RIFFLE: Gradient Maximum 10

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/Observed - Inferred, Other/Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

1st-sample pass--2nd

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/CTB
- SECHI DEPTH

meters

CANOPY

- > 85%- OPEN
- 55%-85%
- 30%-55%
- 10%-30%
- <10%- CLOSED

1st pass 64 cm
2nd pass _____ cm

CJ RECREATION

AREA DEPTH POOL: >100ft² >3ft

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMOURD / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

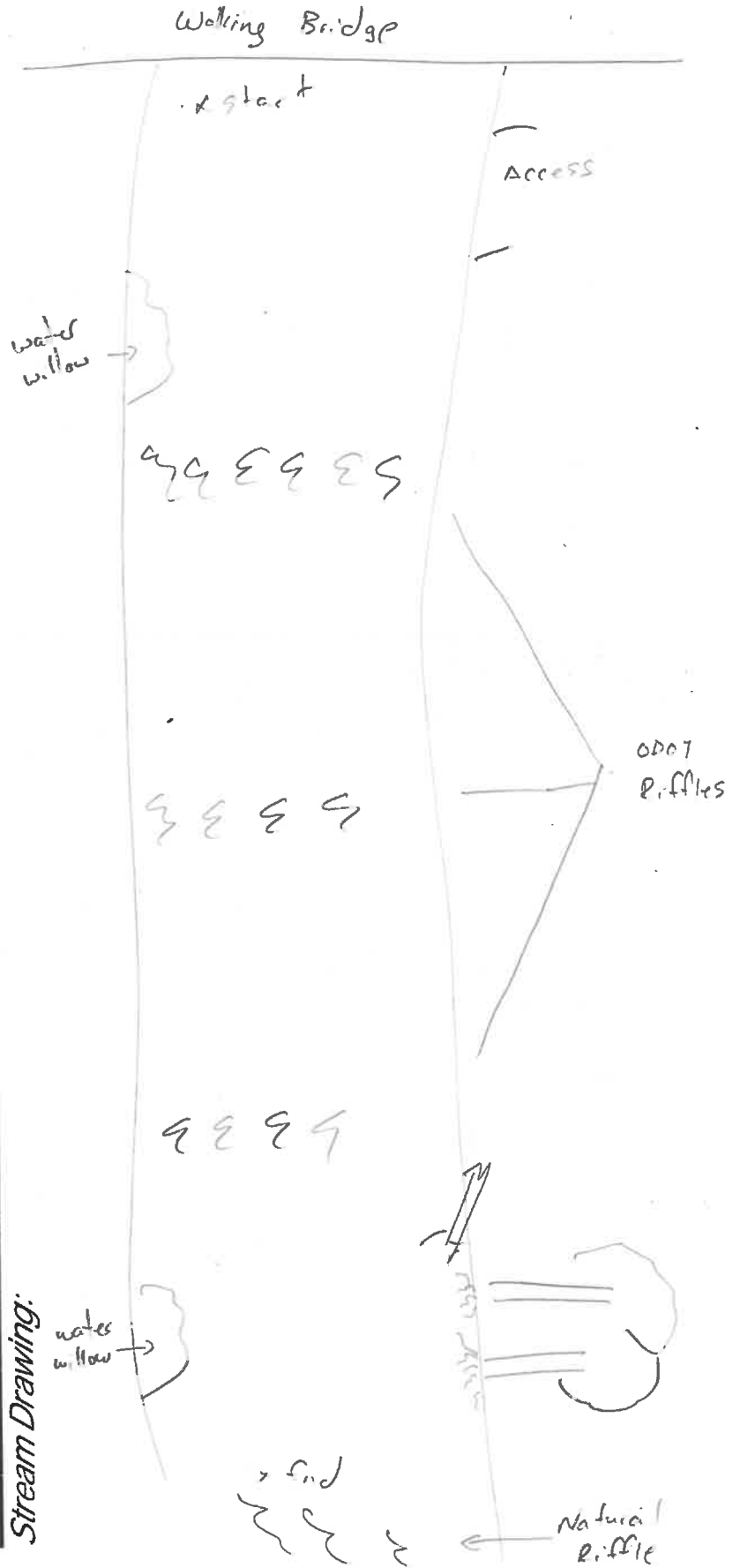
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: ofentany River Ust Henderson Rd RM: 7.1 Date: 8/30/2022
 OLN10 Scorer's Full Name & Affiliation: MBI-MAS
 River Code: 02-400 STORET #: _____ Lat./Long.: 40 183 Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES	POOL RIFFLE	OTHER TYPES	POOL RIFFLE	ORIGIN	QUALITY
<input type="checkbox"/> BLDR /SLABS [10]	<input type="checkbox"/>	<input type="checkbox"/> HARDPAN [4]	<input type="checkbox"/>	<input checked="" type="checkbox"/> LIMESTONE [1]	<input type="checkbox"/> HEAVY [-2]
<input type="checkbox"/> BOULDER [9]	<input checked="" type="checkbox"/>	<input type="checkbox"/> DETRITUS [3]	<input checked="" type="checkbox"/>	<input type="checkbox"/> TILLS [1]	<input type="checkbox"/> MODERATE [-1]
<input checked="" type="checkbox"/> COBBLE [8]	<input checked="" type="checkbox"/>	<input type="checkbox"/> MUCK [2]	<input type="checkbox"/>	<input type="checkbox"/> WETLANDS [0]	<input checked="" type="checkbox"/> NORMAL [0]
<input checked="" type="checkbox"/> GRAVEL [7]	<input checked="" type="checkbox"/>	<input type="checkbox"/> SILT [2]	<input checked="" type="checkbox"/>	<input type="checkbox"/> HARDPAN [0]	<input checked="" type="checkbox"/> FREE [1]
<input type="checkbox"/> SAND [6]	<input checked="" type="checkbox"/>	<input type="checkbox"/> ARTIFICIAL [0]	<input checked="" type="checkbox"/>	<input type="checkbox"/> SANDSTONE [0]	<input type="checkbox"/> EXTENSIVE [-2]
<input type="checkbox"/> BEDROCK [5]	<input type="checkbox"/>			<input type="checkbox"/> RIP/RAP [0]	<input type="checkbox"/> MODERATE [-1]

NUMBER OF BEST TYPES: 4 or more [2] 3 or less [0]

Comments: _____

Check ONE (Or 2 & average)

SILT **EMBEDDEDNESS**

LACUSTURINE [0] SHALE [-1] COAL FINES [-2]

Substrate Maximum 20 11

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

<u>0</u> UNDERCUT BANKS [1]	<u>2</u> POOLS > 70cm [2]	<u>2</u> OXBOWS, BACKWATERS [1]	<input type="checkbox"/> EXTENSIVE >75% [11]
<u>1</u> OVERHANGING VEGETATION [1]	<u>3</u> ROOTWADS [1]	<u>2</u> AQUATIC MACROPHYTES [1]	<input type="checkbox"/> MODERATE 25-75% [7]
<u>3</u> SHALLOWS (IN SLOW WATER) [1]	<u>3</u> BOULDERS [1]	<u>1</u> LOGS OR WOODY DEBRIS [1]	<input type="checkbox"/> SPARSE 5-<25% [3]
<u>3</u> ROOTMATS [1]			<input type="checkbox"/> NEARLY ABSENT <5% [1]

Comments: _____

Check ONE (Or 2 & average)

Cover Maximum 20 11

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
<input type="checkbox"/> HIGH [4]	<input checked="" type="checkbox"/> EXCELLENT [7]	<input type="checkbox"/> NONE [6]	<input checked="" type="checkbox"/> HIGH [3]
<input checked="" type="checkbox"/> MODERATE [3]	<input type="checkbox"/> GOOD [5]	<input checked="" type="checkbox"/> RECOVERED [4]	<input checked="" type="checkbox"/> MODERATE [2]
<input type="checkbox"/> LOW [2]	<input type="checkbox"/> FAIR [3]	<input type="checkbox"/> RECOVERING [3]	<input type="checkbox"/> LOW [1]
<input type="checkbox"/> NONE [1]	<input type="checkbox"/> POOR [1]	<input type="checkbox"/> RECENT OR NO RECOVERY [1]	

Comments: _____

Channel Maximum 20 10.5

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION	RIPARIAN WIDTH	FLOOD PLAIN QUALITY
<input checked="" type="checkbox"/> NONE / LITTLE [3]	<input type="checkbox"/> WIDE > 50m [4]	<input type="checkbox"/> FOREST, SWAMP [3]
<input checked="" type="checkbox"/> MODERATE [2]	<input type="checkbox"/> MODERATE 10-50m [3]	<input type="checkbox"/> SHRUB OR OLD FIELD [2]
<input type="checkbox"/> HEAVY / SEVERE [1]	<input checked="" type="checkbox"/> NARROW 5-10m [2]	<input checked="" type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1]
	<input type="checkbox"/> VERY NARROW < 5m [1]	<input type="checkbox"/> FENCED PASTURE [1]
	<input type="checkbox"/> NONE [0]	<input type="checkbox"/> OPEN PASTURE, ROWCROP [0]

Indicate predominant land use(s) past 100m riparian.

Comments: _____

Conservation Tillage [1] Urban or Industrial [0] Mining / Construction [0]

Riparian Maximum 10 5

5) POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH	CHANNEL WIDTH	CURRENT VELOCITY	Recreation Potential
Check ONE (ONLY!)	Check ONE (Or 2 & average)	Check ALL that apply	Primary Contact
<input checked="" type="checkbox"/> > 1m [6]	<input checked="" type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2]	<input type="checkbox"/> TORRENTIAL [-1]	Secondary Contact
<input type="checkbox"/> 0.7-<1m [4]	<input type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1]	<input checked="" type="checkbox"/> SLOW [1]	(circle one and comment on back)
<input type="checkbox"/> 0.4-<0.7m [2]	<input type="checkbox"/> POOL WIDTH < RIFFLE WIDTH [0]	<input type="checkbox"/> VERY FAST [1]	
<input type="checkbox"/> 0.2-<0.4m [1]		<input checked="" type="checkbox"/> FAST [1]	
<input type="checkbox"/> < 0.2m [0]		<input checked="" type="checkbox"/> MODERATE [1]	
		<input checked="" type="checkbox"/> INTERSTITIAL [-1]	
		<input type="checkbox"/> INTERMITTENT [-2]	
		<input checked="" type="checkbox"/> EDDIES [1]	

Indicate for reach - pools and riffles.

Comments: _____

Pool / Current Maximum 12 12

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
<input checked="" type="checkbox"/> BEST AREAS > 10cm [2]	<input checked="" type="checkbox"/> MAXIMUM > 50cm [2]	<input checked="" type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2]	<input type="checkbox"/> NONE [2]
<input type="checkbox"/> BEST AREAS 5-10cm [1]	<input type="checkbox"/> MAXIMUM < 50cm [1]	<input type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1]	<input type="checkbox"/> LOW [1]
<input type="checkbox"/> BEST AREAS < 5cm [metric=0]		<input type="checkbox"/> UNSTABLE (e.g., Fine Gravel, Sand) [0]	<input checked="" type="checkbox"/> MODERATE [0]
			<input type="checkbox"/> EXTENSIVE [-1]

Check ONE (Or 2 & average). NO RIFFLE [metric=0]

Comments: _____

Riffle / Run Maximum 8 1

6) GRADIENT (2.59 ft/ml) VERY LOW - LOW [2-4] MODERATE [6-10] HIGH - VERY HIGH [10-6]

DRAINAGE AREA (516 mi²)

% POOL: % GLIDE:
 % RUN: % RIFFLE:

Comments: _____

Gradient Maximum 10 8

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85% - OPEN
- 55% - < 85%
- 30% - < 55%
- 10% - < 30%
- < 10% - CLOSED

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

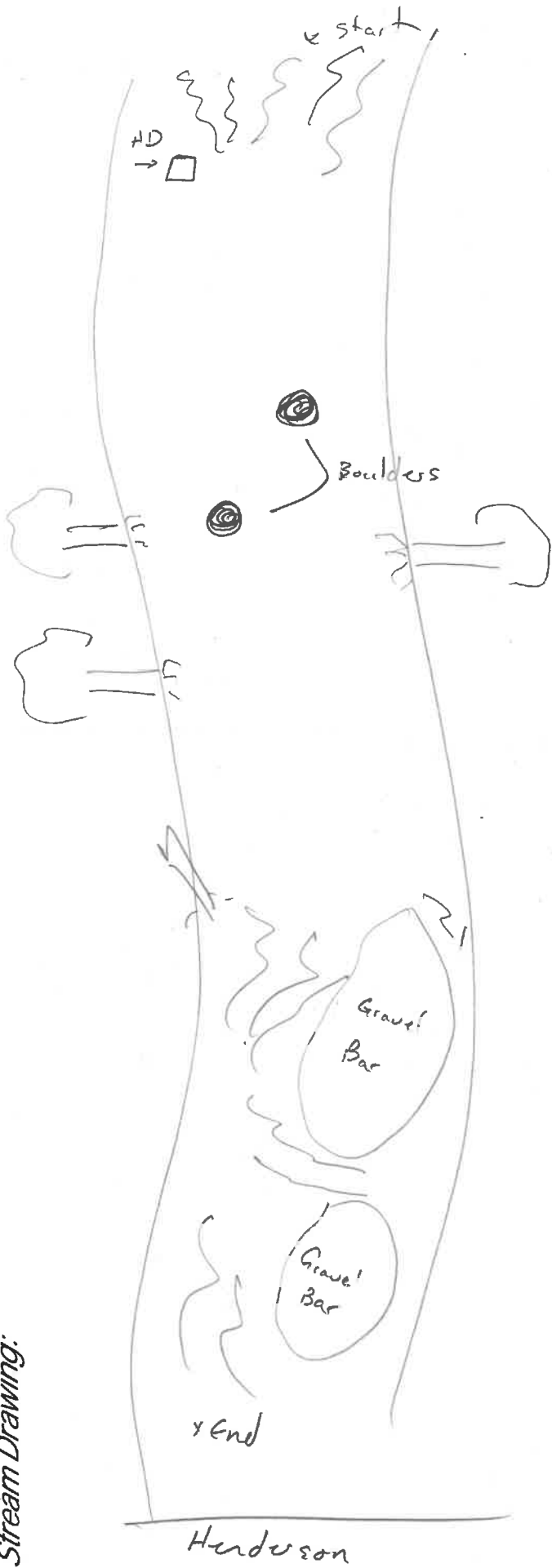
- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

CJ RECREATION

- AREA DEPTH
- POOL: >100ft² >3ft

Stream Drawing:



Stream & Location: Oleantary River - ust. W. N. Broadway - dst. Adena RM. 587 Date: 8/30/2022

DNII Brook Scorers Full Name & Affiliation: MAS-MBI
 River Code: 02-400 STORET#: _____ Lat./Long.: 40 83 Office verified location

1) **SUBSTRATE** Check ONLY two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES		OTHER TYPES		ORIGIN		QUALITY	
<input type="checkbox"/>	<input type="checkbox"/> BLDR /SLABS [10]	<input type="checkbox"/>	<input type="checkbox"/> HARDPAN [4]	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> LIMESTONE [1]	<input type="checkbox"/>	<input type="checkbox"/> HEAVY [-2]
<input type="checkbox"/>	<input type="checkbox"/> BOULDER [9]	<input type="checkbox"/>	<input type="checkbox"/> DETRITUS [3]	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> TILLS [1]	<input checked="" type="checkbox"/>	<input type="checkbox"/> MODERATE [-1]
<input type="checkbox"/>	<input type="checkbox"/> COBBLE [8]	<input type="checkbox"/>	<input type="checkbox"/> MUCK [2]	<input type="checkbox"/>	<input type="checkbox"/> WETLANDS [0]	<input type="checkbox"/>	<input type="checkbox"/> NORMAL [0]
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> GRAVEL [7]	<input type="checkbox"/>	<input type="checkbox"/> SILT [2]	<input type="checkbox"/>	<input type="checkbox"/> HARDPAN [0]	<input type="checkbox"/>	<input type="checkbox"/> FREE [1]
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> SAND [6]	<input type="checkbox"/>	<input type="checkbox"/> ARTIFICIAL [0]	<input type="checkbox"/>	<input type="checkbox"/> SANDSTONE [0]	<input checked="" type="checkbox"/>	<input type="checkbox"/> EXTENSIVE [-2]
<input type="checkbox"/>	<input type="checkbox"/> BEDROCK [5]			<input type="checkbox"/>	<input type="checkbox"/> RIP/RAP [0]	<input checked="" type="checkbox"/>	<input type="checkbox"/> MODERATE [-1]
				<input type="checkbox"/>	<input type="checkbox"/> LACUSTURINE [0]	<input type="checkbox"/>	<input type="checkbox"/> NORMAL [0]
				<input type="checkbox"/>	<input type="checkbox"/> SHALE [-1]	<input type="checkbox"/>	<input type="checkbox"/> NONE [1]
				<input type="checkbox"/>	<input type="checkbox"/> COAL FINES [-2]		

Check ONE (Or 2 & average)

NUMBER OF BEST TYPES: 4 or more [2] 3 or less [0]

Comments _____

Substrate Maximum 14.5 20

2) **INSTREAM COVER** Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

<u>0</u>	<u>3</u>	<u>0</u>	<u>0</u>
<input type="checkbox"/> UNDERCUT BANKS [1]	<input type="checkbox"/> POOLS > 70cm [2]	<input type="checkbox"/> OXBOWS, BACKWATERS [1]	<input type="checkbox"/> AMOUNT
<input checked="" type="checkbox"/> OVERHANGING VEGETATION [1]	<input checked="" type="checkbox"/> ROOTWADS [1]	<input checked="" type="checkbox"/> AQUATIC MACROPHYTES [1]	<input type="checkbox"/> EXTENSIVE >75% [11]
<input type="checkbox"/> SHALLOWS (IN SLOW WATER) [1]	<input type="checkbox"/> BOULDERS [1]	<input type="checkbox"/> LOGS OR WOODY DEBRIS [1]	<input type="checkbox"/> MODERATE 25-75% [7]
<input checked="" type="checkbox"/> ROOTMATS [1]			<input type="checkbox"/> SPARSE 5-<25% [3]
			<input type="checkbox"/> NEARLY ABSENT <5% [1]

Check ONE (Or 2 & average)

Comments _____

Cover Maximum 14 20

3) **CHANNEL MORPHOLOGY** Check ONE in each category (Or 2 & average)

<input type="checkbox"/> HIGH [4]	<input type="checkbox"/> EXCELLENT [7]	<input type="checkbox"/> NONE [6]	<input type="checkbox"/> HIGH [3]
<input type="checkbox"/> MODERATE [3]	<input type="checkbox"/> GOOD [5]	<input type="checkbox"/> RECOVERED [4]	<input checked="" type="checkbox"/> MODERATE [2]
<input type="checkbox"/> LOW [2]	<input type="checkbox"/> FAIR [3]	<input type="checkbox"/> RECOVERING [3]	<input type="checkbox"/> LOW [1]
<input checked="" type="checkbox"/> NONE [1]	<input checked="" type="checkbox"/> POOR [1]	<input checked="" type="checkbox"/> RECENT OR NO RECOVERY [1]	

Channel Maximum 5 20

4) **BANK EROSION AND RIPARIAN ZONE** Check ONE in each category for EACH BANK (Or 2 per bank & average)

<input checked="" type="checkbox"/> NONE / LITTLE [3]	<input type="checkbox"/> WIDE > 50m [4]	<input type="checkbox"/> FOREST, SWAMP [3]	<input type="checkbox"/> CONSERVATION TILLAGE [1]
<input type="checkbox"/> MODERATE [2]	<input type="checkbox"/> MODERATE 10-50m [3]	<input type="checkbox"/> SHRUB OR OLD FIELD [2]	<input type="checkbox"/> URBAN OR INDUSTRIAL [0]
<input type="checkbox"/> HEAVY / SEVERE [1]	<input checked="" type="checkbox"/> NARROW 5-10m [2]	<input checked="" type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1]	<input type="checkbox"/> MINING / CONSTRUCTION [0]
	<input type="checkbox"/> VERY NARROW < 5m [1]	<input type="checkbox"/> FENCED PASTURE [1]	
	<input type="checkbox"/> NONE [0]	<input type="checkbox"/> OPEN PASTURE, ROWCROP [0]	

Indicate predominant land use(s) past 100m riparian.

Riparian Maximum 6 10

5) **POOL / GLIDE AND RIFFLE / RUN QUALITY**

<input checked="" type="checkbox"/> > 1m [6]	<input type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2]	<input type="checkbox"/> TORRENTIAL [-1]	<input checked="" type="checkbox"/> SLOW [1]
<input type="checkbox"/> 0.7-1m [4]	<input type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1]	<input type="checkbox"/> VERY FAST [1]	<input type="checkbox"/> INTERSTITIAL [-1]
<input type="checkbox"/> 0.4-0.7m [2]	<input checked="" type="checkbox"/> POOL WIDTH < RIFFLE WIDTH [0]	<input type="checkbox"/> FAST [1]	<input type="checkbox"/> INTERMITTENT [-2]
<input type="checkbox"/> 0.2-0.4m [1]		<input type="checkbox"/> MODERATE [1]	<input type="checkbox"/> EDDIES [1]
<input type="checkbox"/> < 0.2m [0]			

Check ONE (ONLY!) for MAXIMUM DEPTH. Check ONE (Or 2 & average) for CHANNEL WIDTH. Check ALL that apply for CURRENT VELOCITY.

Indicate for reach - pools and riffles.

Recreation Potential: Primary Contact, Secondary Contact (circle one and comment on back)

Pool / Current Maximum 7 12

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). NO RIFFLE [metric=0]

<input type="checkbox"/> BEST AREAS > 10cm [2]	<input type="checkbox"/> MAXIMUM > 50cm [2]	<input type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2]	<input type="checkbox"/> NONE [2]
<input type="checkbox"/> BEST AREAS 5-10cm [1]	<input type="checkbox"/> MAXIMUM < 50cm [1]	<input type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1]	<input type="checkbox"/> LOW [1]
<input checked="" type="checkbox"/> BEST AREAS < 5cm [metric=0]		<input type="checkbox"/> UNSTABLE (e.g., Fine Gravel, Sand) [0]	<input type="checkbox"/> MODERATE [0]
			<input type="checkbox"/> EXTENSIVE [-1]

Riffle / Run Maximum 0 8

6) **GRADIENT** (2.59 ft/mi) VERY LOW - LOW [2-4] MODERATE [6-10] HIGH - VERY HIGH [10-6]

DRAINAGE AREA (524 mi²)

%POOL: %GLIDE:
 %RUN: %RIFFLE:

Gradient Maximum 8 10

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH
Check ALL that apply

- METHOD**
- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

- DISTANCE**
- 0.5 Km
 - 0.2 Km
 - 0.15 Km
 - 0.12 Km
 - OTHER
- CLARITY**
- 1st --sample pass-- 2nd
 - < 20 cm
 - 20-40 cm
 - 40-70 cm
 - > 70 cm/ CTB
 - SECCHI DEPTH
- CANOPY** meters
- > 85% - OPEN
 - 55% - < 85%
 - 30% - < 55%
 - 10% - < 30%
 - < 10% - CLOSED

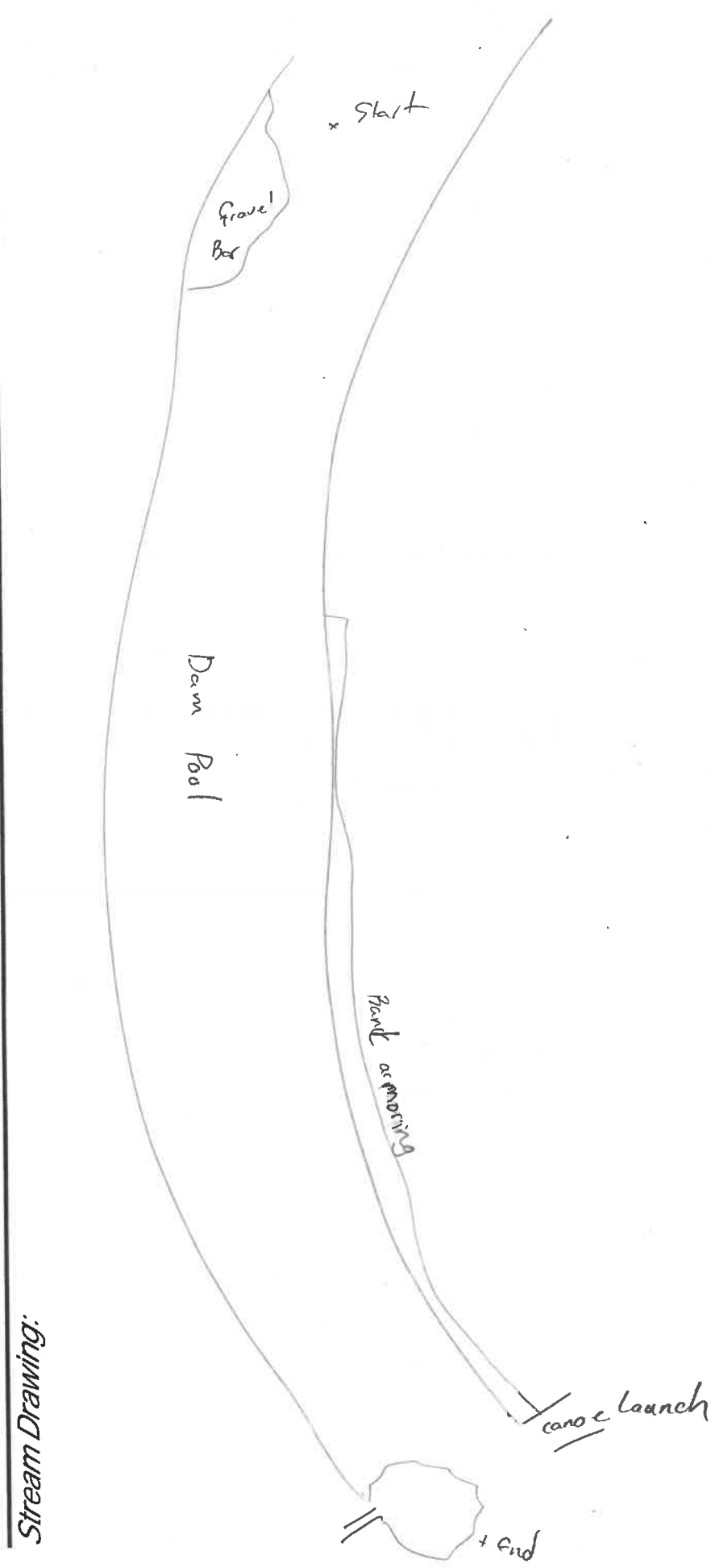
- BJ AESTHETICS**
- NUISANCE ALGAE
 - INVASIVE MACROPHYTES
 - EXCESS TURBIDITY
 - DISCOLORATION
 - FOAM / SCUM
 - OIL SHEEN
 - TRASH / LITTER
 - NUISANCE ODOR
 - SLUDGE DEPOSITS
 - CSOs/SSOs/OUTFALLS
- AREA DEPTH**
- POOL: > 100ft² > 3ft

- DJ MAINTENANCE**
- PUBLIC / PRIVATE / BOTH / NA
 - ACTIVE / HISTORIC / BOTH / NA
 - YOUNG-SUCCESSION-OLD
 - SPRAY / SNAG / REMOVED
 - MODIFIED / DIPPED OUT / NA
 - LEVEED / ONE SIDED
 - RELOCATED / CUTOFFS
 - MOVING-BEDLOAD-STABLE
 - ARMoured / SLUMPS
 - ISLANDS / SCoured
 - IMPOUNDED / DESICCATED
 - FLOOD CONTROL / DRAINAGE

- EI ISSUES**
- WWTP / CSO / NPDES / INDUSTRY
 - HARDENED / URBAN / DIRT & GRIME
 - CONTAMINATED / LANDFILL
 - BMPs-CONSTRUCTION-SEDIMENT
 - LOGGING / IRRIGATION / COOLING
 - BANK / EROSION / SURFACE
 - FALSE BANK / MANURE / LAGOON
 - WASH H₂O / TILE / H₂O TABLE
 - ACID / MINE / QUARRY / FLOW
 - NATURAL / WETLAND / STAGNANT
 - PARK / GOLF / LAWN / HOME
 - ATMOSPHERE / DATA PAUCITY

- FI MEASUREMENTS**
- \bar{x} width
 - \bar{x} depth
 - max. depth
 - \bar{x} bankfull width
 - bankfull \bar{x} depth
 - W/D ratio
 - bankfull max. depth
 - floodprone \bar{x}^2 width
 - entrench. ratio
- Legacy Tree:

CJ RECREATION



Stream Drawing:

Stream & Location: Olentangy River Upst Dadebridge RM: 4.45 Date: 8/29/2022

BLN12 Scorers Full Name & Affiliation: MBI - MAS Office verified location []

River Code: 02-400 STORET #: Lat./Long.: 40.182

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Substrate assessment table with columns: BEST TYPES, OTHER TYPES, ORIGIN, QUALITY. Includes checkboxes for Bldr/Slabs, Boulder, Cobble, Gravel, Sand, Bedrock, Hardpan, Detritus, Muck, Silts, Artificial, Limestone, Tills, Wetlands, Hardpan, Sandstone, Rip/Rap, Lacustrine, Shale, Coal Fines. Includes a 'Substrate' box with 'H.S.' and 'Maximum 20'.

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

Instream Cover assessment table with columns: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS (IN SLOW WATER), ROOTMATS, POOLS > 70cm, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes an 'AMOUNT' box with 'Moderate 25-75%' and 'Maximum 20'.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel Morphology assessment table with columns: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes checkboxes for High, Moderate, Low, None in each category. Includes a 'Channel' box with 'Maximum 20'.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Bank Erosion and Riparian Zone assessment table with columns: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes checkboxes for None/Little, Moderate, Heavy/Severe, Wide, Moderate, Narrow, Very Narrow, None, Forest/Swamp, Shrub/Old Field, Residential/Park/New Field, Fenced Pasture, Open Pasture/Rowcrop, Conservation Tillage, Urban/Industrial, Mining/Construction. Includes a 'Riparian' box with 'Maximum 10'.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY

Pool/Glide and Riffle/Run Quality assessment table with columns: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY. Includes checkboxes for depth ranges, width comparisons, and velocity types. Includes a 'Recreation Potential' box with 'Primary Contact' and 'Secondary Contact' and a 'Pool/Current' box with 'Maximum 12'.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average).

Riffle assessment table with columns: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes checkboxes for best areas, maximum/minimum depths, stable/mod/unstable substrates, and embeddedness levels. Includes a 'Riffle/Run' box with 'Maximum 8'.

6) GRADIENT (2.59 ft/ml) DRAINAGE AREA (529 mi²) %POOL: %GLIDE: %RUN: %RIFFLE: Gradient Maximum 10

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- HIGH
- UP
- NORMAL
- LOW
- DRY

1st sample pass-- 2nd

- CLARITY**
- < 20 cm
 - 20-<40 cm
 - 40-70 cm
 - > 70 cm/ CTB
- SECCHI DEPTH**
- 1st pass 60 cm
 - 2nd pass _____ cm

meters

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%- CLOSED

CJ RECREATION

AREA DEPTH

- >100ft²
- >3ft

BJ AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

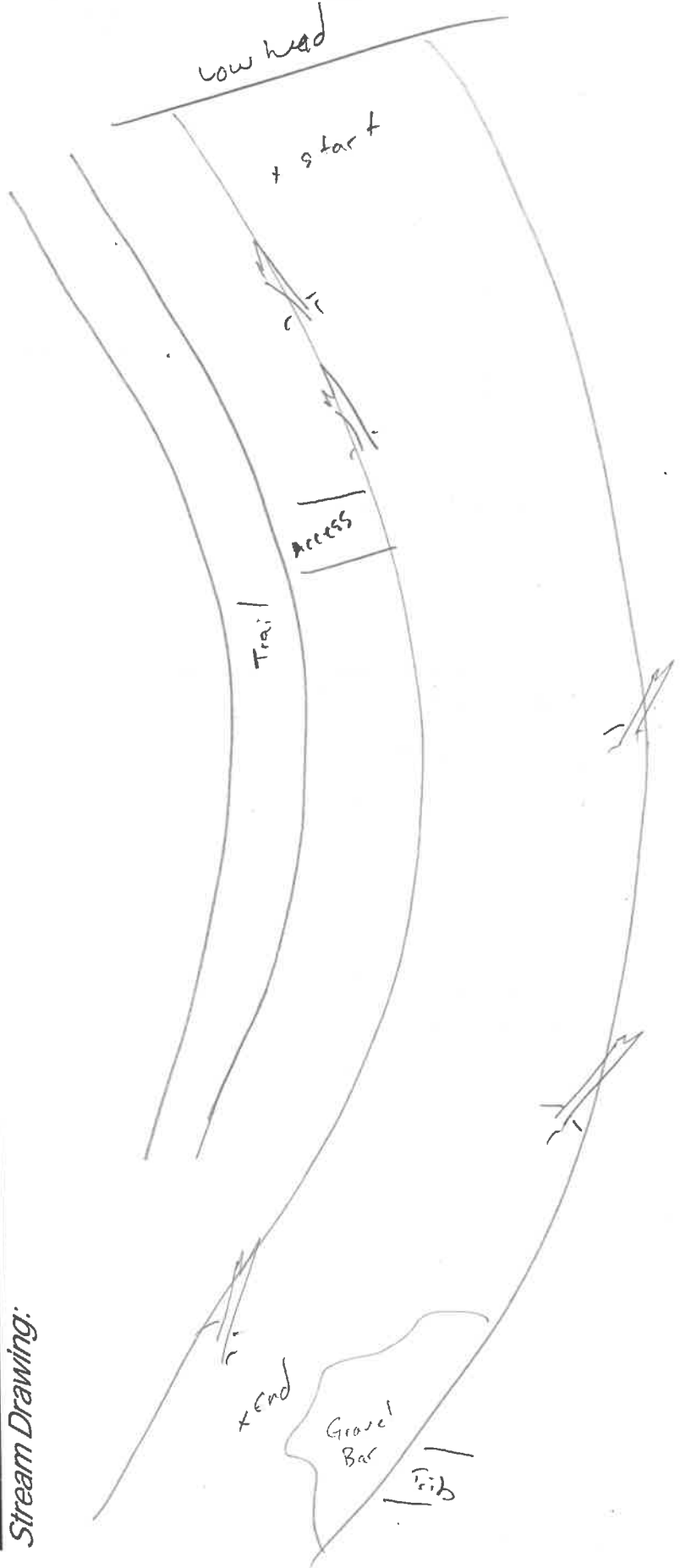
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x} width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Adena Brook - Park of Roses RM: 0.23 Date: 7/12/2022

ADNo: _____ Scorers Full Name & Affiliation: MBI - MAS
 River Code: 02-401 - STORET #: _____ Lat./Long.: 40 _____ 18 3. Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

BEST TYPES		OTHER TYPES		ORIGIN		QUALITY	
<input type="checkbox"/> BLDR /SLABS [10]	<input type="checkbox"/> POOL RIFFLE	<input type="checkbox"/> HARDPAN [4]	<input type="checkbox"/> POOL RIFFLE	<input type="checkbox"/> LIMESTONE [1]	<input type="checkbox"/> SILT	<input type="checkbox"/> HEAVY [-2]	Substrate <u>16.5</u> Maximum 20
<input type="checkbox"/> BOULDER [9]	<input checked="" type="checkbox"/> <u>x</u>	<input type="checkbox"/> DETRITUS [3]	<input type="checkbox"/>	<input checked="" type="checkbox"/> TILLS [1]	<input type="checkbox"/>	<input type="checkbox"/> MODERATE [-1]	
<input checked="" type="checkbox"/> COBBLE [8]	<input checked="" type="checkbox"/> <u>x</u>	<input type="checkbox"/> MUCK [2]	<input type="checkbox"/>	<input type="checkbox"/> WETLANDS [0]	<input type="checkbox"/>	<input type="checkbox"/> NORMAL [0]	
<input checked="" type="checkbox"/> GRAVEL [7]	<input checked="" type="checkbox"/> <u>x</u>	<input type="checkbox"/> SILT [2]	<input checked="" type="checkbox"/> <u>x</u>	<input type="checkbox"/> HARDPAN [0]	<input type="checkbox"/>	<input checked="" type="checkbox"/> FREE [1]	
<input type="checkbox"/> SAND [6]	<input checked="" type="checkbox"/> <u>x</u>	<input type="checkbox"/> ARTIFICIAL [0]	<input type="checkbox"/>	<input type="checkbox"/> SANDSTONE [0]	<input type="checkbox"/>	<input type="checkbox"/> EXTENSIVE [-2]	
<input type="checkbox"/> BEDROCK [5]	<input checked="" type="checkbox"/> <u>x</u>	(Score natural substrates; ignore sludge from point-sources)		<input type="checkbox"/> RIP/RAP [0]	<input type="checkbox"/>	<input type="checkbox"/> MODERATE [-1]	

NUMBER OF BEST TYPES: 4 or more [2] 3 or less [0]

Comments: _____

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed rootwad in deep / fast water, or deep, well-defined, functional pools.

<u>3</u> UNDERCUT BANKS [1]	<u>1</u> POOLS > 70cm [2]	<u>0</u> OXBOWS, BACKWATERS [1]	Amount Check ONE (Or 2 & average) <input type="checkbox"/> EXTENSIVE >75% [11] <input checked="" type="checkbox"/> MODERATE 25-75% [7] <input type="checkbox"/> SPARSE 5-<25% [3] <input type="checkbox"/> NEARLY ABSENT <5% [1] Cover Maximum 20 16
<u>1</u> OVERHANGING VEGETATION [1]	<u>3</u> ROOTWADS [1]	<u>0</u> AQUATIC MACROPHYTES [1]	
<u>3</u> SHALLOWS (IN SLOW WATER) [1]	<u>2</u> BOULDERS [1]	<u>3</u> LOGS OR WOODY DEBRIS [1]	
<u>3</u> ROOTMATS [1]			

Comments: _____

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	Channel Maximum 20 13
<input type="checkbox"/> HIGH [4]	<input type="checkbox"/> EXCELLENT [7]	<input type="checkbox"/> NONE [6]	<input type="checkbox"/> HIGH [3]	
<input checked="" type="checkbox"/> MODERATE [3]	<input checked="" type="checkbox"/> GOOD [5]	<input checked="" type="checkbox"/> RECOVERED [4]	<input checked="" type="checkbox"/> MODERATE [2]	
<input type="checkbox"/> LOW [2]	<input checked="" type="checkbox"/> FAIR [3]	<input type="checkbox"/> RECOVERING [3]	<input type="checkbox"/> LOW [1]	

Comments: _____

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

EROSION	RIPARIAN WIDTH	FLOOD PLAIN QUALITY	Riparian Maximum 10 6.5
<input checked="" type="checkbox"/> NONE / LITTLE [3]	<input checked="" type="checkbox"/> WIDE > 50m [4]	<input type="checkbox"/> FOREST, SWAMP [3]	
<input checked="" type="checkbox"/> MODERATE [2]	<input type="checkbox"/> MODERATE 10-50m [3]	<input type="checkbox"/> SHRUB OR OLD FIELD [2]	
<input type="checkbox"/> HEAVY / SEVERE [1]	<input type="checkbox"/> NARROW 5-10m [2]	<input checked="" type="checkbox"/> RESIDENTIAL, PARK, NEW FIELD [1]	

Comments: _____

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH Check ONE (ONLY!)	CHANNEL WIDTH Check ONE (Or 2 & average)	CURRENT VELOCITY Check ALL that apply	Recreation Potential Primary Contact Secondary Contact (circle one and comment on back) Pool / Current Maximum 12 8
<input type="checkbox"/> > 1m [6]	<input checked="" type="checkbox"/> POOL WIDTH > RIFFLE WIDTH [2]	<input type="checkbox"/> TORRENTIAL [-1]	
<input checked="" type="checkbox"/> 0.7-<1m [4]	<input type="checkbox"/> POOL WIDTH = RIFFLE WIDTH [1]	<input type="checkbox"/> VERY FAST [1]	
<input type="checkbox"/> 0.4-<0.7m [2]	<input type="checkbox"/> POOL WIDTH < RIFFLE WIDTH [0]	<input type="checkbox"/> FAST [1]	

Comments: _____

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). NO RIFFLE [metric=0]

RIFFLE DEPTH	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS	Riffle / Run Maximum 8 3.5
<input type="checkbox"/> BEST AREAS > 10cm [2]	<input type="checkbox"/> MAXIMUM > 50cm [2]	<input checked="" type="checkbox"/> STABLE (e.g., Cobble, Boulder) [2]	<input type="checkbox"/> NONE [2]	
<input checked="" type="checkbox"/> BEST AREAS 5-10cm [1]	<input checked="" type="checkbox"/> MAXIMUM < 50cm [1]	<input checked="" type="checkbox"/> MOD. STABLE (e.g., Large Gravel) [1]	<input type="checkbox"/> LOW [1]	
<input type="checkbox"/> BEST AREAS < 5cm [metric=0]		<input type="checkbox"/> UNSTABLE (e.g., Fine Gravel, Sand) [0]	<input checked="" type="checkbox"/> MODERATE [0]	

Comments: _____

6] GRADIENT (22.2 ft/mi) VERY LOW - LOW [2-4] MODERATE [6-10] HIGH - VERY HIGH [10-6]

DRAINAGE AREA (2.71 mi²)

%POOL: %GLIDE:
 %RUN: %RIFFLE:

Gradient Maximum 10 10

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- 1st--sample pass--2nd
 - HIGH
 - UP
 - NORMAL
 - LOW
 - DRY
- DISTANCE**
- 0.5 Km
 - 0.2 Km
 - 0.15 Km
 - 0.12 Km
 - OTHER

CLARITY

- 1st--sample pass-- 2nd
- < 20 cm
- 20--<40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85%- OPEN
- 55%--<85%
- 30%--<55%
- 10%--<30%
- <10%--CLOSED

- 1st _____ cm
- 2nd _____ cm

CJ RECREATION

AREA DEPTH
POOL: >100ff² >3ft

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

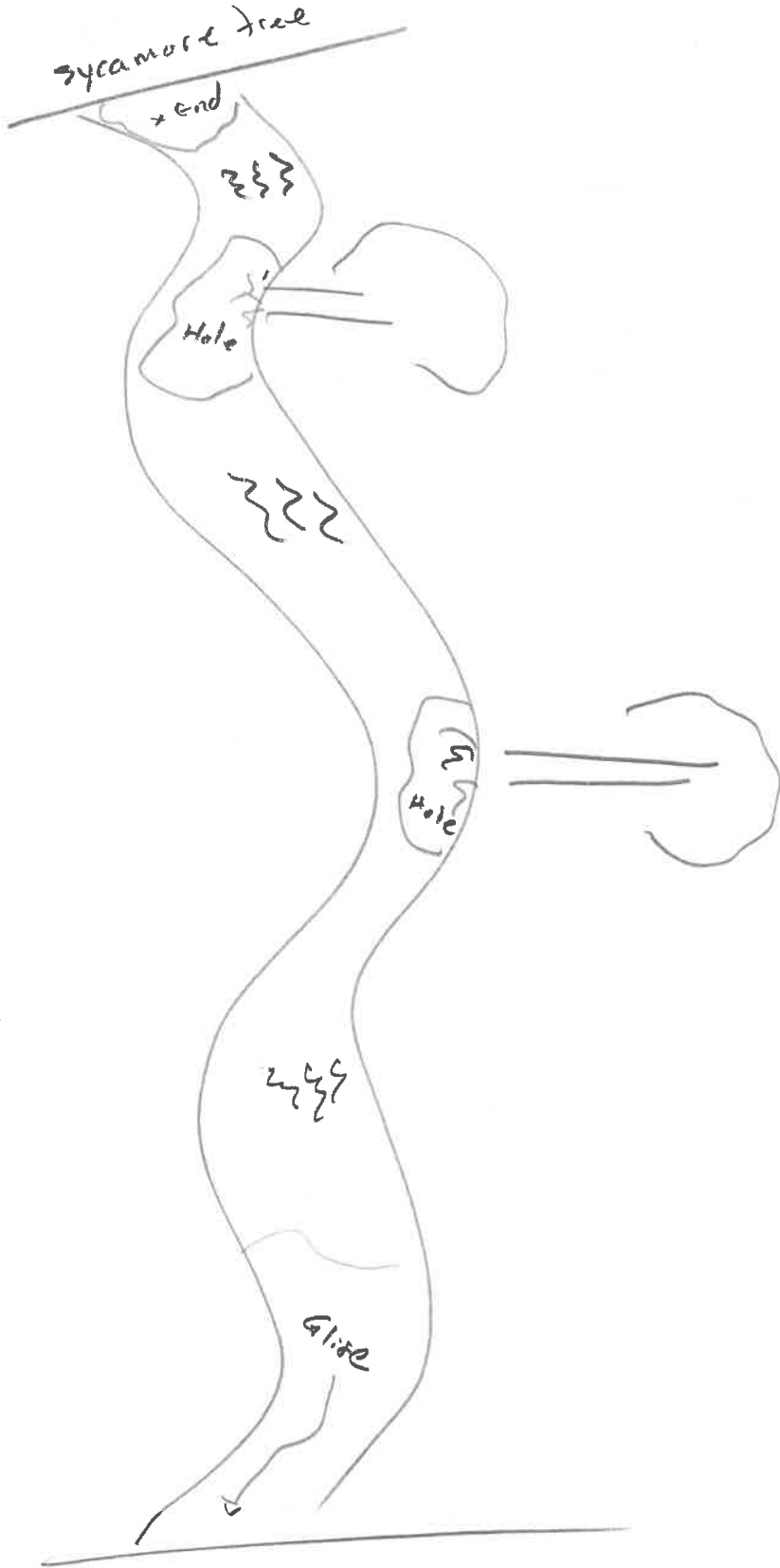
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Adena Brook dst N. High St. RM: 0.52 Date: 7/12/2022

ADNOZ Scorers Full Name & Affiliation: MBI-MAS
River Code: 02-401- STORET #: Lat./Long.: 40.183 Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. Check ONE (Or 2 & average). BEST TYPES: BLDR/SLABS [10], BOULDER [9], COBBLE [8], GRAVEL [7], SAND [6], BEDROCK [5]. OTHER TYPES: HARDPAN [4], DETRITUS [3], MUCK [2], SILT [2], ARTIFICIAL [0]. ORIGIN: LIMESTONE [1], TILLS [1], WETLANDS [0], HARDPAN [0], SANDSTONE [0], RIP/RAP [0], LACUSTURINE [0], SHALE [-1], COAL FINES [-2]. QUALITY: HEAVY [-2], MODERATE [-1], NORMAL [0], FREE [1], EXTENSIVE [-2], MODERATE [-1], NORMAL [0], NONE [1].

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts. AMOUNT: Check ONE (Or 2 & average). EXTENSIVE >75% [11], MODERATE 25-75% [7], SPARSE 5-<25% [3], NEARLY ABSENT <5% [1].

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). SINUOSITY: HIGH [4], MODERATE [3], LOW [2], NONE [1]. DEVELOPMENT: EXCELLENT [7], GOOD [5], FAIR [3], POOR [1]. CHANNELIZATION: NONE [6], RECOVERED [4], RECOVERING [3], RECENT OR NO RECOVERY [1]. STABILITY: HIGH [3], MODERATE [2], LOW [1].

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). RIVER RIGHT LOOKING DOWNSTREAM. EROSION: NONE/LITTLE [3], MODERATE [2], HEAVY/SEVERE [1]. RIPARIAN WIDTH: WIDE > 50m [4], MODERATE 10-50m [3], NARROW 5-10m [2], VERY NARROW < 5m [1], NONE [0]. FLOOD PLAIN QUALITY: FOREST, SWAMP [3], SHRUB OR OLD FIELD [2], RESIDENTIAL, PARK, NEW FIELD [1], FENCED PASTURE [1], OPEN PASTURE, ROWCROP [0]. CONSERVATION TILLAGE [1], URBAN OR INDUSTRIAL [0], MINING / CONSTRUCTION [0].

5] POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH: > 1m [6], 0.7-<1m [4], 0.4-<0.7m [2], 0.2-<0.4m [1], < 0.2m [0]. CHANNEL WIDTH: POOL WIDTH > RIFFLE WIDTH [2], POOL WIDTH = RIFFLE WIDTH [1], POOL WIDTH < RIFFLE WIDTH [0]. CURRENT VELOCITY: TORRENTIAL [-1], VERY FAST [1], FAST [1], MODERATE [1], SLOW [1], INTERSTITIAL [-1], INTERMITTENT [-2], EDDIES [1]. Recreation Potential: Primary Contact, Secondary Contact. Pool / Current Maximum 12.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). NO RIFFLE [metric=0]. RIFFLE DEPTH: BEST AREAS > 10cm [2], BEST AREAS 5-10cm [1], BEST AREAS < 5cm [metric=0]. RUN DEPTH: MAXIMUM > 50cm [2], MAXIMUM < 50cm [1]. RIFFLE / RUN SUBSTRATE: STABLE (e.g., Cobble, Boulder) [2], MOD. STABLE (e.g., Large Gravel) [1], UNSTABLE (e.g., Fine Gravel, Sand) [0]. RIFFLE / RUN EMBEDDEDNESS: NONE [2], LOW [1], MODERATE [0], EXTENSIVE [-1]. Riffle / Run Maximum 8.

6] GRADIENT (40.0 ft/mi) DRAINAGE AREA (2.66 mi^2). VERY LOW - LOW [2-4], MODERATE [6-10], HIGH - VERY HIGH [10-6]. %POOL: %GLIDE: Gradient Maximum 10.

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

A) SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- 1st --sample pass-- 2nd
- HIGH
- UP
- NORMAL
- LOW
- DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- < 20 cm
- 20-<40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%- CLOSED

C) RECREATION

- AREA
- DEPTH
- POOL: >100ft² >3ft

B) AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

D) MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCLOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

E) ISSUES

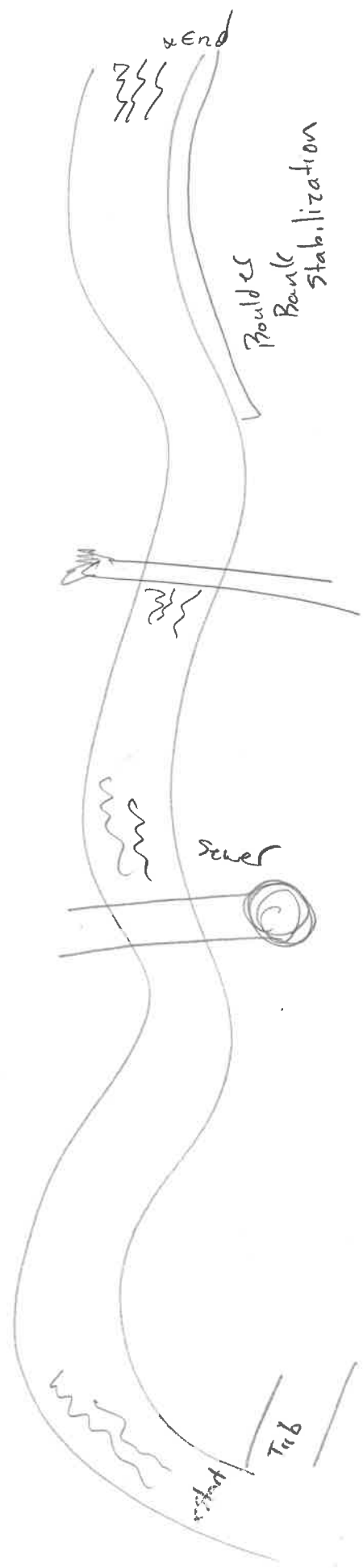
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

F) MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Adena Brook - Overbrook Dr., dst Canyon Dr. RM: 0.8 Date: 7/12/2012

ADNo 3

Scorers Full Name & Affiliation: HBI-MAS

River Code: 02-401 STORET#: Lat/Long: 40.183 Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Check ONE (Or 2 & average)

Substrate assessment table with columns: BEST TYPES, OTHER TYPES, ORIGIN, QUALITY. Includes checkboxes for BLDR/SLABS, BOULDER, COBBLE, GRAVEL, SAND, BEDROCK, etc.

NUMBER OF BEST TYPES: 4 or more [2] 3 or less [0]

Comments

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts... quality; 3-Highest quality in moderate or greater amounts

AMOUNT

Check ONE (Or 2 & average)

Instream Cover assessment table with columns: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS

Comments

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel Morphology assessment table with columns: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY

Comments

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Bank Erosion and Riparian Zone assessment table with columns: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY, CONSERVATION TILLAGE, URBAN OR INDUSTRIAL, MINING / CONSTRUCTION

Comments

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

Pool/Glide and Riffle/Run Quality assessment table with columns: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY

Comments

Recreation Potential Primary Contact Secondary Contact

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Check ONE (Or 2 & average).

NO RIFFLE [metric=0]

Riffle/Run Quality assessment table with columns: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS

Comments

6] GRADIENT (47.6 ft/mi) DRAINAGE AREA (2.28 mi^2) VERY LOW - LOW [2-4] MODERATE [6-10] HIGH - VERY HIGH [10-6]

%POOL: %GLIDE: %RUN: %RIFFLE:

Gradient Maximum 10

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

A) SAMPLED REACH
Check ALL that apply

METHOD

- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

1st - sample pass - 2nd

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- < 20 cm
- 20-40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85% - OPEN
- 55% - < 85%
- 30% - < 55%
- 10% - < 30%
- < 10% - CLOSED

C) RECREATION

AREA DEPTH

- POOL: > 100ft² > 3ft

B) AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

D) MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

E) ISSUES

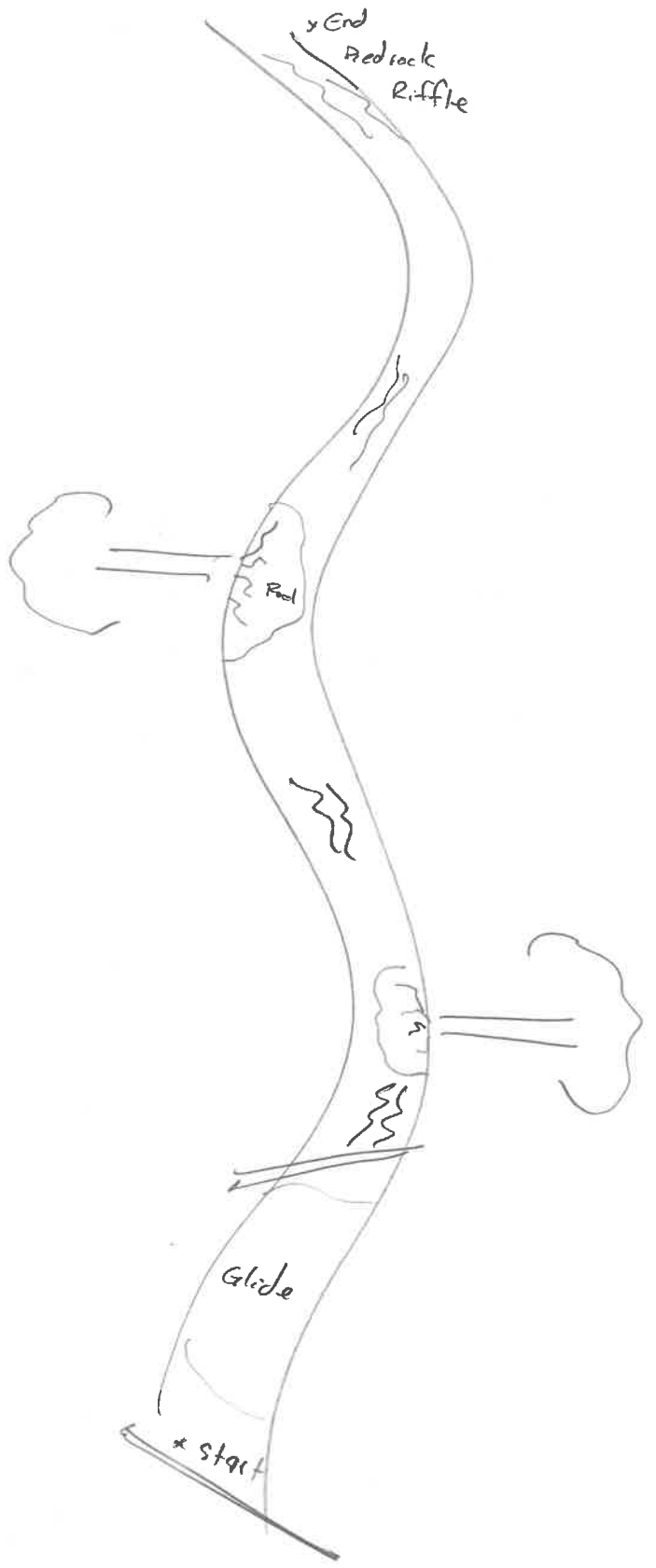
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT & GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

F) MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Adena Brook - Overbrook Dr + Yaronia Dr. RM: 1.7 Date: 7/12/2022

ADNo 4 Scorers Full Name & Affiliation: MBI - MAS

River Code: 02-401 STORET#: Lat/Long: 40.0 183. Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. Check ONE (Or 2 & average). BEST TYPES: BLDR /SLABS [10], BOULDER [9], COBBLE [8], GRAVEL [7], SAND [6], BEDROCK [5]. OTHER TYPES: HARDPAN [4], DETRITUS [3], MUCK [2], SILT [2], ARTIFICIAL [0]. ORIGIN: LIMESTONE [1], TILLS [1], WETLANDS [0], HARDPAN [0], SANDSTONE [0], RIP/RAP [0], LACUSTURINE [0], SHALE [-1], COAL FINES [-2]. QUALITY: HEAVY [-2], MODERATE [-1], NORMAL [0], FREE [1], EXTENSIVE [-2], MODERATE [-1], NORMAL [0], NONE [1].

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts. AMOUNT: Check ONE (Or 2 & average). UNDERCUT BANKS [1], OVERHANGING VEGETATION [1], SHALLOWS (IN SLOW WATER) [1], ROOTMATS [1]. POOLS > 70cm [2], ROOTWADS [1], BOULDERS [1]. OXBOWS, BACKWATERS [1], AQUATIC MACROPHYTES [1], LOGS OR WOODY DEBRIS [1].

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). SINUOSITY: HIGH [4], MODERATE [3], LOW [2], NONE [1]. DEVELOPMENT: EXCELLENT [7], GOOD [5], FAIR [3], POOR [1]. CHANNELIZATION: NONE [6], RECOVERED [4], RECOVERING [3], RECENT OR NO RECOVERY [1]. STABILITY: HIGH [3], MODERATE [2], LOW [1].

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). River right looking downstream. EROSION: NONE / LITTLE [3], MODERATE [2], HEAVY / SEVERE [1]. RIPARIAN WIDTH: WIDE > 50m [4], MODERATE 10-50m [3], NARROW 5-10m [2], VERY NARROW < 5m [1], NONE [0]. FLOOD PLAIN QUALITY: FOREST, SWAMP [3], SHRUB OR OLD FIELD [2], RESIDENTIAL, PARK, NEW FIELD [1], FENCED PASTURE [1], OPEN PASTURE, ROWCROP [0]. CONSERVATION TILLAGE [1], URBAN OR INDUSTRIAL [0], MINING / CONSTRUCTION [0].

5] POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH: > 1m [6], 0.7-<1m [4], 0.4-<0.7m [2], 0.2-<0.4m [1], < 0.2m [0]. CHANNEL WIDTH: POOL WIDTH > RIFFLE WIDTH [2], POOL WIDTH = RIFFLE WIDTH [1], POOL WIDTH < RIFFLE WIDTH [0]. CURRENT VELOCITY: TORRENTIAL [-1], VERY FAST [1], FAST [1], MODERATE [1], SLOW [1], INTERSTITIAL [-1], INTERMITTENT [-2], EDDIES [1]. Recreation Potential: Primary Contact, Secondary Contact.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species. Check ONE (Or 2 & average). RIFFLE DEPTH: BEST AREAS > 10cm [2], BEST AREAS 5-10cm [1], BEST AREAS < 5cm [metric=0]. RUN DEPTH: MAXIMUM > 50cm [2], MAXIMUM < 50cm [1]. RIFFLE / RUN SUBSTRATE: STABLE (e.g., Cobble, Boulder) [2], MOD. STABLE (e.g., Large Gravel) [1], UNSTABLE (e.g., Fine Gravel, Sand) [0]. RIFFLE / RUN EMBEDDEDNESS: NONE [2], LOW [1], MODERATE [0], EXTENSIVE [-1].

6] GRADIENT (40.0 ft/mi) DRAINAGE AREA (1.8 mi^2). VERY LOW - LOW [2-4], MODERATE [6-10], HIGH - VERY HIGH [10-6]. %POOL: %GLIDE: %RUN: %RIFFLE:

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH
Check ALL that apply

METHOD

- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- < 20 cm
- 20-<40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%- CLOSED

BI/AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPounded / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

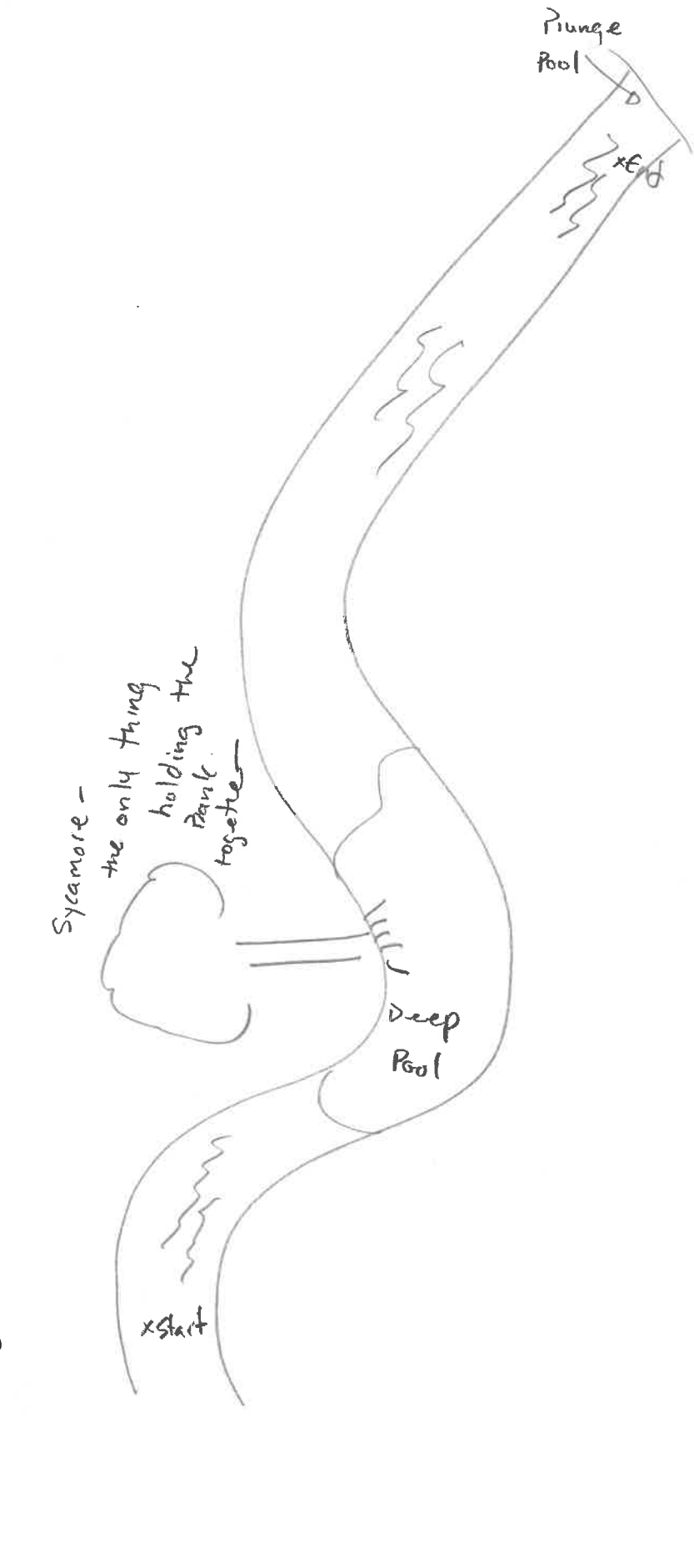
- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:

CJ RECREATION

- AREA
- DEPTH
- POOL: >100ft² >3ft

Stream Drawing:



Stream & Location: Glen Echo Ravine - Glen Echo Park RM: 0.25 Date: 7/27/2022

GE201 Scorers Full Name & Affiliation: MAS -> MBI River Code: 02-465 STORET#: Lat/Long: 40.182 Office verified location

Handwritten numbers: 16, 10, 26, 16, 42, 15, 57, 12, 69, 16, 85, 14, 99

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. Check ONE (Or 2 & average). BEST TYPES: BLDR/SLABS, BOULDER, COBBLE, GRAVEL, SAND, BEDROCK. OTHER TYPES: HARDPAN, DETRITUS, MUCK, SILT, ARTIFICIAL. ORIGIN: LIMESTONE, TILLS, WETLANDS, SANDSTONE, RIP/RAP, LACUSTURINE, SHALE, COAL FINES. QUALITY: HEAVY, MODERATE, NORMAL, FREE, EXTENSIVE, MODERATE, NORMAL, NONE.

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts... AMOUNT Check ONE (Or 2 & average). UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. EXTENSIVE, MODERATE, SPARSE, NEARLY ABSENT.

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). SINUOSITY: HIGH, MODERATE, LOW, NONE. DEVELOPMENT: EXCELLENT, GOOD, FAIR, POOR. CHANNELIZATION: NONE, RECOVERED, RECOVERING, RECENT OR NO RECOVERY. STABILITY: HIGH, MODERATE, LOW.

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). EROSION: NONE/LITTLE, MODERATE, HEAVY/SEVERE. RIPARIAN WIDTH: WIDE, MODERATE, NARROW, VERY NARROW, NONE. FLOOD PLAIN QUALITY: FOREST/SWAMP, SHRUB/OLD FIELD, RESIDENTIAL/PARK/NEW FIELD, FENCED PASTURE, OPEN PASTURE/ROWCROP. CONSERVATION TILLAGE, URBAN/INDUSTRIAL, MINING/CONSTRUCTION.

5] POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH: >1m, 0.7-1m, 0.4-0.7m, 0.2-0.4m, <0.2m. CHANNEL WIDTH: POOL WIDTH > RIFFLE WIDTH, POOL WIDTH = RIFFLE WIDTH, POOL WIDTH < RIFFLE WIDTH. CURRENT VELOCITY: TORRENTIAL, VERY FAST, FAST, MODERATE, SLOW, INTERSTITIAL, INTERMITTENT, EDDIES. Recreation Potential: Primary Contact, Secondary Contact.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). NO RIFFLE. RIFFLE DEPTH: BEST AREAS >10cm, 5-10cm, <5cm. RUN DEPTH: MAXIMUM >50cm, <50cm. RIFFLE / RUN SUBSTRATE: STABLE, MOD. STABLE, UNSTABLE. RIFFLE / RUN EMBEDDEDNESS: NONE, LOW, MODERATE, EXTENSIVE.

6] GRADIENT (142.9 ft/mi) DRAINAGE AREA (0.59 mi^2) VERY LOW - LOW, MODERATE, HIGH - VERY HIGH. %POOL, %GLIDE, %RUN, %RIFFLE.

AJ SAMPLED REACH

Check ALL that apply

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- 1st --sample pass-- 2nd
- HIGH
- UP
- NORMAL
- LOW
- DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- < 20 cm
- 20-<40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%-CLOSED

CJ RECREATION

AREA DEPTH
POOL: >100ft² >3ft

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

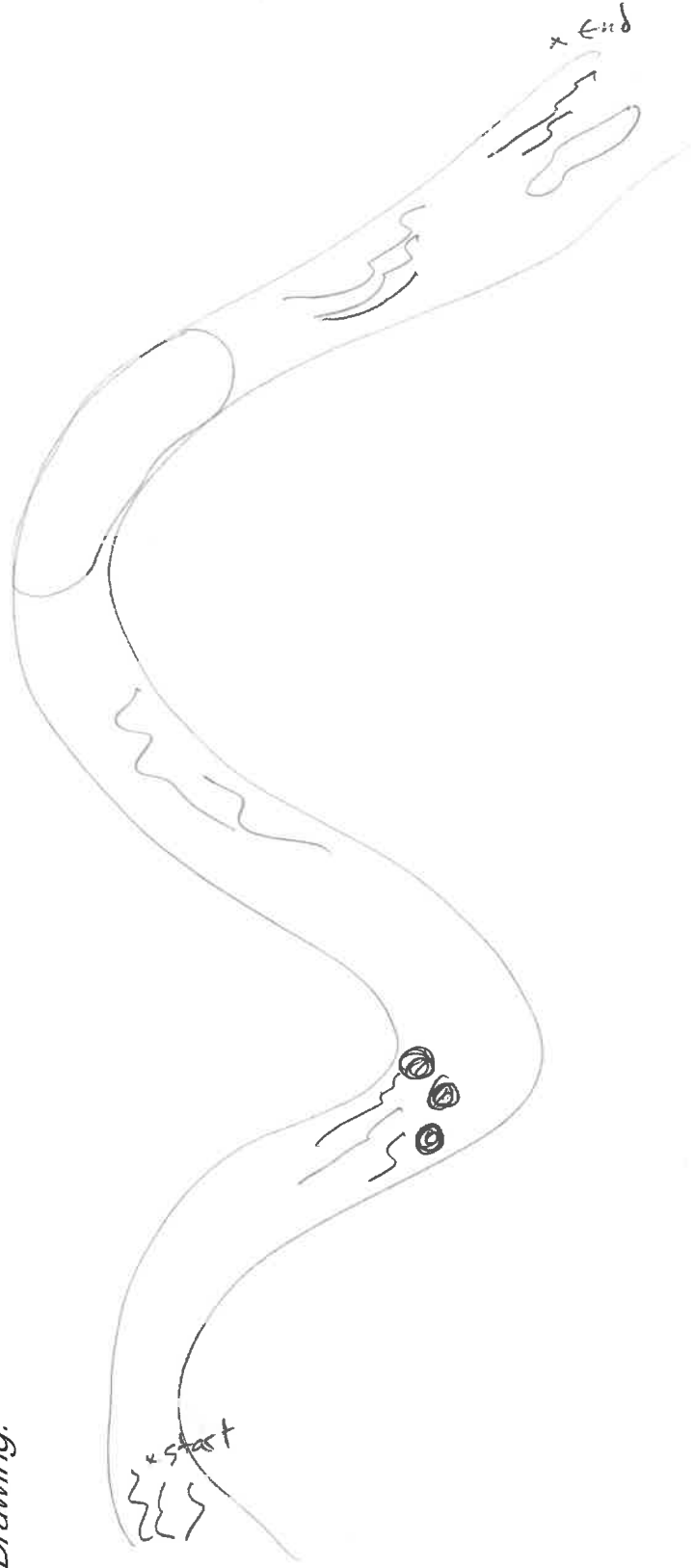
FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x} width
- entrench. ratio

CJ RECREATION

AREA DEPTH
POOL: >100ft² >3ft

Stream Drawing:



Stream & Location: Turkey Run, 1st Tillbury Ave, RM: 0.7, Date: 7/12/2022

TURD, Scorers Full Name & Affiliation: MBJ - MAS, River Code: 02-402, STORET#: , Lat/Long: 40.183, Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. Check ONE (Or 2 & average). BEST TYPES: BLDR / SLABS [10], BOULDER [9], COBBLE [8], GRAVEL [7], SAND [6], BEDROCK [5]. OTHER TYPES: HARDPAN [4], DETRITUS [3], MUCK [2], SILT [2], ARTIFICIAL [0]. ORIGIN: LIMESTONE [1], TILLS [1], WETLANDS [0], HARDPAN [0], SANDSTONE [0], RIP/RAP [0], LACUSTURINE [0], SHALE [-1], COAL FINES [-2]. QUALITY: HEAVY [-2], MODERATE [-1], NORMAL [0], FREE [1], EXTENSIVE [-2], MODERATE [-1], NORMAL [0], NONE [1]. NUMBER OF BEST TYPES: 4 or more [2], 3 or less [0]. Comments: Substrate Maximum 20, Score: 17.5

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts. Check ONE (Or 2 & average). UNDERCUT BANKS [1], OVERHANGING VEGETATION [1], SHALLOWS (IN SLOW WATER) [1], ROOTMATS [1]. POOLS > 70cm [2], ROOTWADS [1], BOULDERS [1]. OXBOWS, BACKWATERS [1], AQUATIC MACROPHYTES [1], LOGS OR WOODY DEBRIS [1]. AMOUNT: EXTENSIVE >75% [11], MODERATE 25-75% [7], SPARSE 5-<25% [3], NEARLY ABSENT <5% [1]. Comments: Cover Maximum 20, Score: 14

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). SINUOSITY: HIGH [4], MODERATE [3], LOW [2], NONE [1]. DEVELOPMENT: EXCELLENT [7], GOOD [5], FAIR [3], POOR [1]. CHANNELIZATION: NONE [6], RECOVERED [4], RECOVERING [3], RECENT OR NO RECOVERY [1]. STABILITY: HIGH [3], MODERATE [2], LOW [1]. Comments: Channel Maximum 20, Score: 11

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). River right looking downstream. EROSION: NONE / LITTLE [3], MODERATE [2], HEAVY / SEVERE [1]. RIPARIAN WIDTH: WIDE > 50m [4], MODERATE 10-50m [3], NARROW 5-10m [2], VERY NARROW < 5m [1], NONE [0]. FLOOD PLAIN QUALITY: FOREST, SWAMP [3], SHRUB OR OLD FIELD [2], RESIDENTIAL, PARK, NEW FIELD [1], FENCED PASTURE [1], OPEN PASTURE, ROWCROP [0]. CONSERVATION TILLAGE [1], URBAN OR INDUSTRIAL [0], MINING / CONSTRUCTION [0]. Comments: Riparian Maximum 10, Score: 5

5] POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH: > 1m [6], 0.7-<1m [4], 0.4-<0.7m [2], 0.2-<0.4m [1], < 0.2m [0]. CHANNEL WIDTH: POOL WIDTH > RIFFLE WIDTH [2], POOL WIDTH = RIFFLE WIDTH [1], POOL WIDTH < RIFFLE WIDTH [0]. CURRENT VELOCITY: TORRENTIAL [-1], VERY FAST [1], FAST [1], MODERATE [1], SLOW [1], INTERSTITIAL [-1], INTERMITTENT [-2], EDDIES [1]. Recreation Potential: Primary Contact, Secondary Contact. Comments: Pool / Current Maximum 12, Score: 6

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species. Check ONE (Or 2 & average). RIFFLE DEPTH: BEST AREAS > 10cm [2], BEST AREAS 5-10cm [1], BEST AREAS < 5cm [metric=0]. RUN DEPTH: MAXIMUM > 50cm [2], MAXIMUM < 50cm [1]. RIFFLE / RUN SUBSTRATE: STABLE (e.g., Cobble, Boulder) [2], MOD. STABLE (e.g., Large Gravel) [1], UNSTABLE (e.g., Fine Gravel, Sand) [0]. RIFFLE / RUN EMBEDDEDNESS: NONE [2], LOW [1], MODERATE [0], EXTENSIVE [-1]. Comments: Riffle / Run Maximum 8, Score: 6

6] GRADIENT (26.3 ft/mi) DRAINAGE AREA (2.09 mi^2). VERY LOW - LOW [2-4], MODERATE [6-10], HIGH - VERY HIGH [10-6]. %POOL: , %GLIDE: , %RUN: , %RIFFLE: . Gradient Maximum 10, Score: 10

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH
Check ALL that apply

METHOD

- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

1st--sample pass-- 2nd

CLARITY

- < 20 cm
- 20-<40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%- CLOSED

CJ RECREATION

AREA DEPTH
POOL: >100ft² >3ft

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

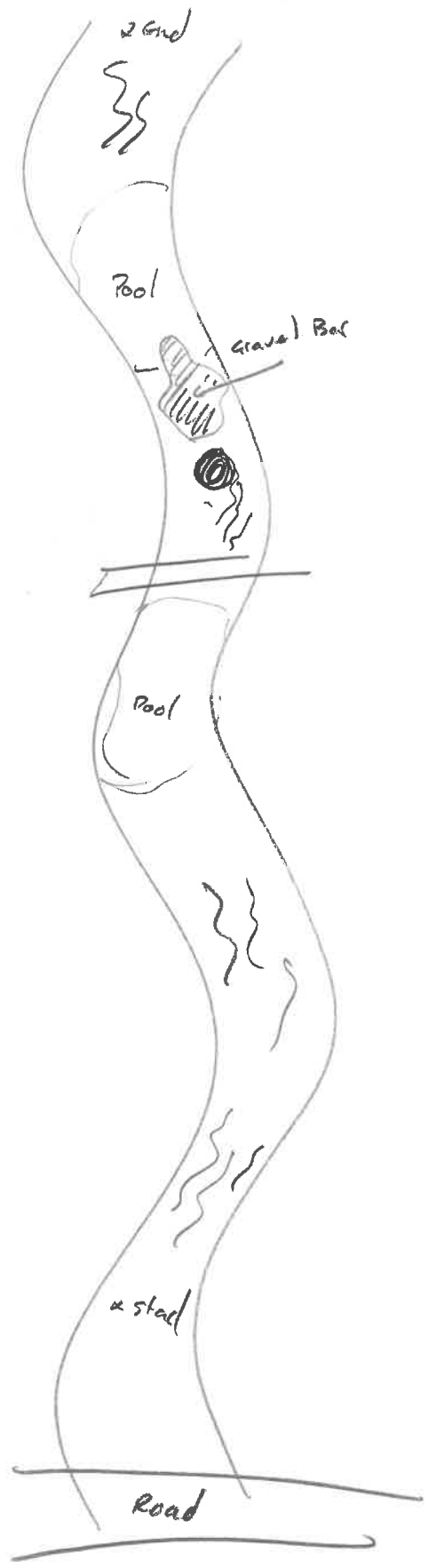
EJ ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:



Stream Drawing:

Stream & Location: Tributary to Olentangy River @ RM 8.45

RM: 0.1 Date: 7/11/2022

TEL BOI

Scorers Full Name & Affiliation: MAS -> MBZ

River Code: 02-492-

STORET#:

Lat/Long: 40

183

Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Check ONE (Or 2 & average)

Substrate assessment grid with categories: BEST TYPES, OTHER TYPES, POOL RIFFLE, and NUMBER OF BEST TYPES.

Substrate assessment grid with categories: ORIGIN and QUALITY.

Substrate Maximum 20

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts

AMOUNT

Check ONE (Or 2 & average)

Instream cover assessment grid with categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS.

Instream cover assessment grid with categories: EXTENSIVE, MODERATE, SPARSE, NEARLY ABSENT.

Cover Maximum 20

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel morphology assessment grid with categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY.

Channel Maximum 20

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Bank erosion and riparian zone assessment grid with categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY, CONSERVATION TILLAGE, URBAN OR INDUSTRIAL, MINING / CONSTRUCTION.

Riparian Maximum 10

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

Pool / glide and riffle / run quality assessment grid with categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY.

Recreation Potential Primary Contact Secondary Contact

Pool / Current Maximum 12

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Check ONE (Or 2 & average).

NO RIFFLE [metric=0]

Riffle / run quality assessment grid with categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS.

Riffle / Run Maximum 8

Gradient and drainage area assessment grid with categories: GRADIENT, DRAINAGE AREA.

Gradient and drainage area assessment grid with categories: %POOL, %GLIDE, %RUN, %RIFFLE.

Gradient Maximum 10

Handwritten numbers on the left margin: 16, 14, 30, 25, 55, 12, 68, 8, 76, 17, 93, 11, 104, 38, 142.

AJ SAMPLED REACH

Check ALL that apply

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- 1st --sample pass-- 2nd
- HIGH
- UP
- NORMAL
- LOW
- DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- < 20 cm
- 20-<40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%- CLOSED

B/AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

D/J MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

E/I ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

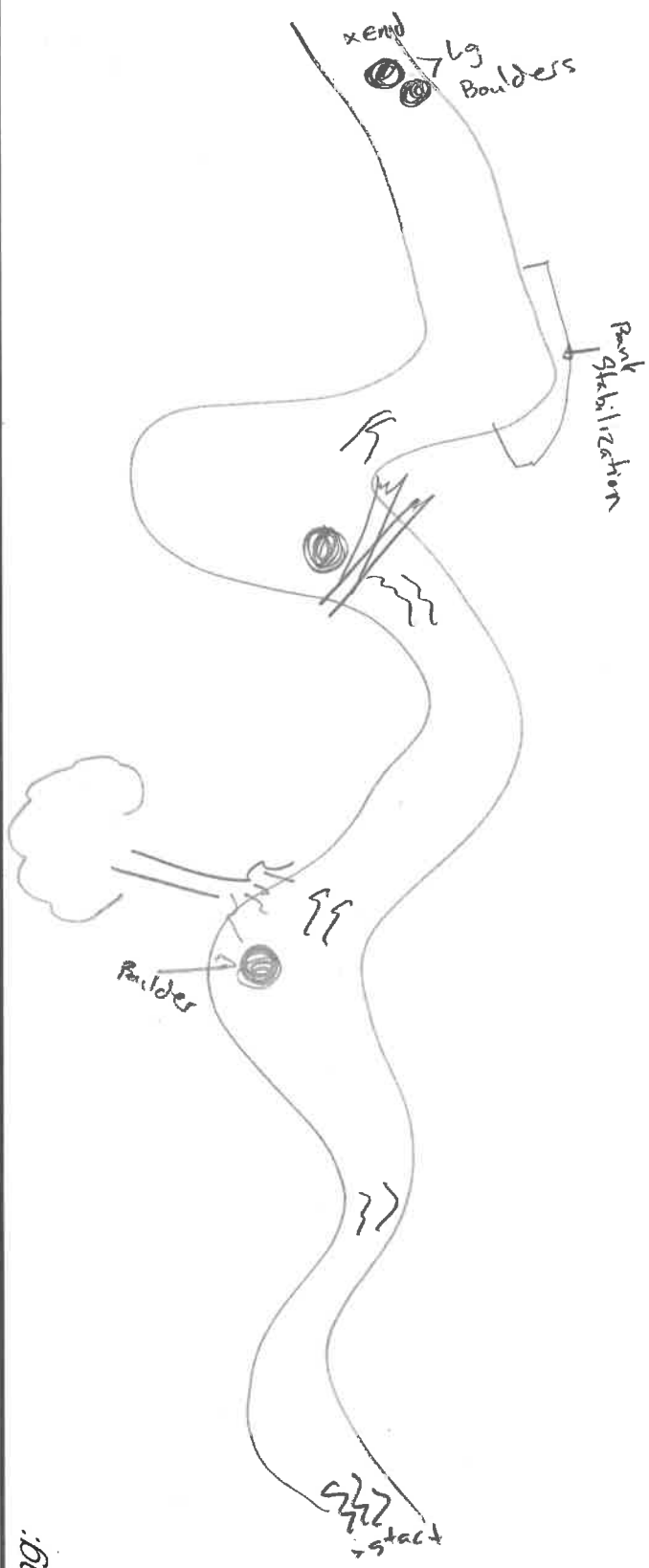
F/J MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x} width
- entrench. ratio

C/J RECREATION

AREA DEPTH
POOL: >100ft² >3ft

Stream Drawing:



Stream & Location: Linworth Run West Linworth Rd RM: 0.8 Date: 7/11/2022

LINO Scorers Full Name & Affiliation: MBI-MAS

River Code: 02-442 STORET#: Lat/Long: 40 183 Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Check ONE (Or 2 & average)

Substrate assessment table with categories: BEST TYPES, OTHER TYPES, ORIGIN, QUALITY. Includes handwritten marks and a score of 18.5 in a box.

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts...

AMOUNT

Check ONE (Or 2 & average)

Instream cover assessment table with categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes handwritten marks and a score of 13 in a box.

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel morphology assessment table with categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes handwritten marks.

Channel Maximum 20 11

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Bank erosion and riparian zone assessment table with categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes handwritten marks and a score of 6 in a box.

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

Pool/glide and riffle/run quality assessment table with categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY. Includes handwritten marks.

Recreation Potential Primary Contact Secondary Contact

Pool / Current Maximum 12 5

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Check ONE (Or 2 & average).

NO RIFFLE [metric=0]

Riffle/run quality assessment table with categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes handwritten marks and a score of 5.5 in a box.

6] GRADIENT (58.8 ft/mi) DRAINAGE AREA (2.58 mi^2)

%POOL: %GLIDE: %RUN: %RIFFLE:

Gradient Maximum 10 4

Handwritten numbers: 21, 9, 30, 27, 57, 57, 114

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- 1st --sample pass-- 2nd
 - HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- < 20 cm
- 20-<40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%- CLOSED

- 1st _____ cm
- 2nd _____ cm

CJ RECREATION

- AREA DEPTH
- POOL: >100ft? >3ft

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

Honey Suckle prevalent in understory. Some mature cottonwood trees

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCLOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

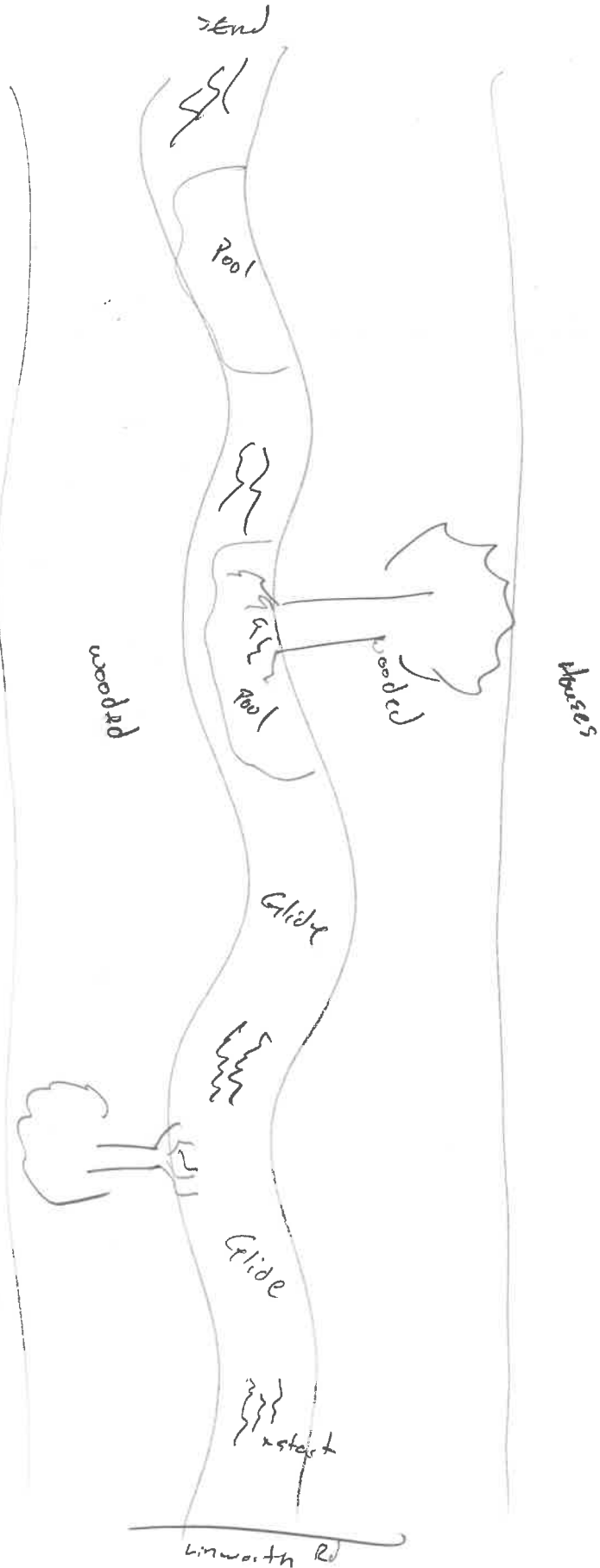
- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
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- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x} width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Stream & Location: Bartholomew Run Ust. Bennett Pkwy RM: 0.7 Date: 7/11/2022

BA201

Scorers Full Name & Affiliation: MAS -> MBI

River Code: 02-404- STORET #: Lat/Long: 40. 183. Office verified location

Handwritten numbers on the left margin: 23, 10, 33, 5, 38, 8, 46, 4, 50, 12, 62, 14, 76, 8, 84, 25, 109, 6, 115, 20, 135

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Substrate assessment grid with categories: BEST TYPES, OTHER TYPES, ORIGIN, and QUALITY. Includes checkboxes for BLDR/SLABS, BOULDER, COBBLE, GRAVEL, SAND, BEDROCK, etc. Includes a circled score of 13.5.

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts

Instream Cover assessment grid with categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes a circled score of 14.

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel Morphology assessment grid with categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes a circled score of 15.

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Bank Erosion and Riparian Zone assessment grid with categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY. Includes a circled score of 6.

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

Pool / Glide and Riffle / Run Quality assessment grid with categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY, Recreation Potential. Includes a circled score of 6.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Riffle / Run Quality assessment grid with categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes a circled score of 5.

Gradient and Drainage Area assessment grid with categories: GRADIENT, DRAINAGE AREA. Includes a circled score of 4.

Comment RE: Reach consistency/Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

A1 SAMPLED REACH
Check ALL that apply

- METHOD**
- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- 1st -sample pass-- 2nd
 - HIGH
 - UP
 - NORMAL
 - LOW
 - DRY
- DISTANCE**
- 0.5 Km
 - 0.2 Km
 - 0.15 Km
 - 0.12 Km
 - OTHER

- CLARITY**
- 1st --sample pass-- 2nd
 - < 20 cm
 - 20-<40 cm
 - 40-70 cm
 - > 70 cm/ CTB
 - SECCHI DEPTH
- meters
- CANOPY**
- > 85%- OPEN
 - 55%-<85%
 - 30%-<55%
 - 10%-<30%
 - <10%- CLOSED

- B/AESTHETICS**
- NUISANCE ALGAE
 - INVASIVE MACROPHYTES
 - EXCESS TURBIDITY
 - DISCOLORATION
 - FOAM / SCUM
 - OIL SHEEN
 - TRASH / LITTER
 - NUISANCE ODOR
 - SLUDGE DEPOSITS
 - CSOs/SSOs/OUTFALLS
- C/J RECREATION** AREA DEPTH
- POOL: >100ft² >3ft

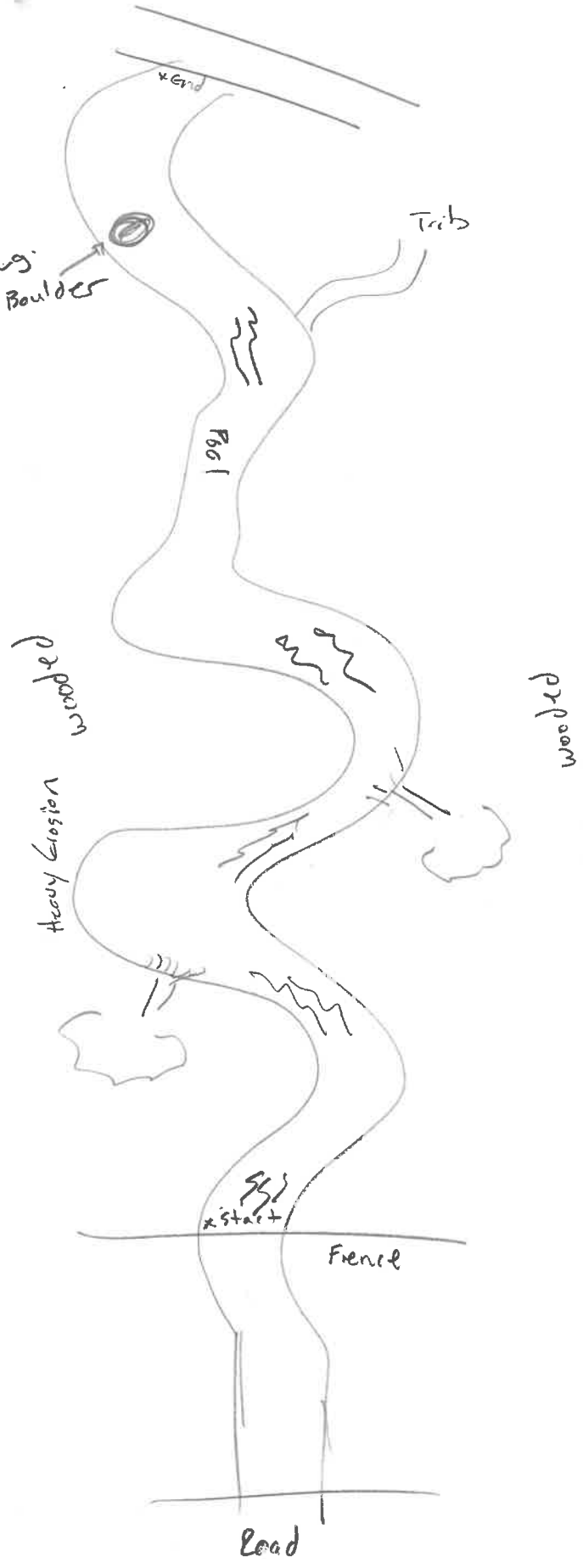
- D/J MAINTENANCE**
- PUBLIC / PRIVATE / BOTH / NA
 - ACTIVE / HISTORIC / BOTH / NA
 - YOUNG-SUCCESSION-OLD
 - SPRAY / SNAG / REMOVED
 - MODIFIED / DIPPED OUT / NA
 - LEVEED / ONE SIDED
 - RELOCATED / CUTOFFS
 - MOVING-BEDLOAD-STABLE
 - ARMoured / SLUMPS
 - ISLANDS / SCoured
 - IMPOUNDED / DESICCATED
 - FLOOD CONTROL / DRAINAGE

- Circle some & COMMENT

- E/J ISSUES**
- WWTP / CSO / NPDES / INDUSTRY
 - HARDENED / URBAN / DIRT&GRIME
 - CONTAMINATED / LANDFILL
 - BMPs-CONSTRUCTION-SEDIMENT
 - LOGGING / IRRIGATION / COOLING
 - BANK / EROSION / SURFACE
 - FALSE BANK / MANURE / LAGOON
 - WASH H₂O / TILE / H₂O TABLE
 - ACID / MINE / QUARRY / FLOW
 - NATURAL / WETLAND / STAGNANT
 - PARK / GOLF / LAWN / HOME
 - ATMOSPHERE / DATA PAUCITY

- F/J MEASUREMENTS**
- width
 - depth
 - max. depth
 - bankfull width
 - bankfull x depth
 - W/D ratio
 - bankfull max. depth
 - floodprone x² width
 - entrench. ratio
- Legacy Tree:

Stream Drawing:



Stream & Location: Rush Run - ust. confluence w/ Olentangy River RM: 0.2 Date: 7/11/2022

R5401

Scorers Full Name & Affiliation: MAS - MRI

River Code: 02-403-

STORET#: _____

Lat/Long: 40. _____

183. _____

Office verified location

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Check ONE (Or 2 & average)

Substrate assessment grid with categories: BEST TYPES, OTHER TYPES, ORIGIN, QUALITY. Includes checkboxes for BLDR/SLABS, BOULDER, COBBLE, GRAVEL, SAND, BEDROCK, etc.

Comments

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts...

AMOUNT

Check ONE (Or 2 & average)

Instream Cover assessment grid with categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS.

Comments

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel Morphology assessment grid with categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY.

Comments

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Bank Erosion and Riparian Zone assessment grid with categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY.

Comments

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

Pool/Glide and Riffle/Run Quality assessment grid with categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY.

Comments

Recreation Potential box with Primary Contact and Secondary Contact options.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Check ONE (Or 2 & average).

NO RIFFLE [metric=0]

Riffle/Run Quality assessment grid with categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS.

Comments

6] GRADIENT (62.5 ft/mi) DRAINAGE AREA (2.62 mi^2) assessment grid with categories: VERY LOW - LOW, MODERATE, HIGH - VERY HIGH.

%POOL, %GLIDE, %RUN, %RIFFLE assessment grid.

Gradient Maximum 10 assessment box.

AJ SAMPLED REACH

Check ALL that apply

METHOD

- BOAT
 - WADE
 - L. LINE
 - OTHER
- STAGE**
- 1st-sample pass-- 2nd
 - HIGH
 - UP
 - NORMAL
 - LOW
 - DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- < 20 cm
- 20-<40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%- CLOSED

CJ RECREATION

- AREA
- DEPTH
- POOL: >100ft? >3ft

BJAESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

DJ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

EJ ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

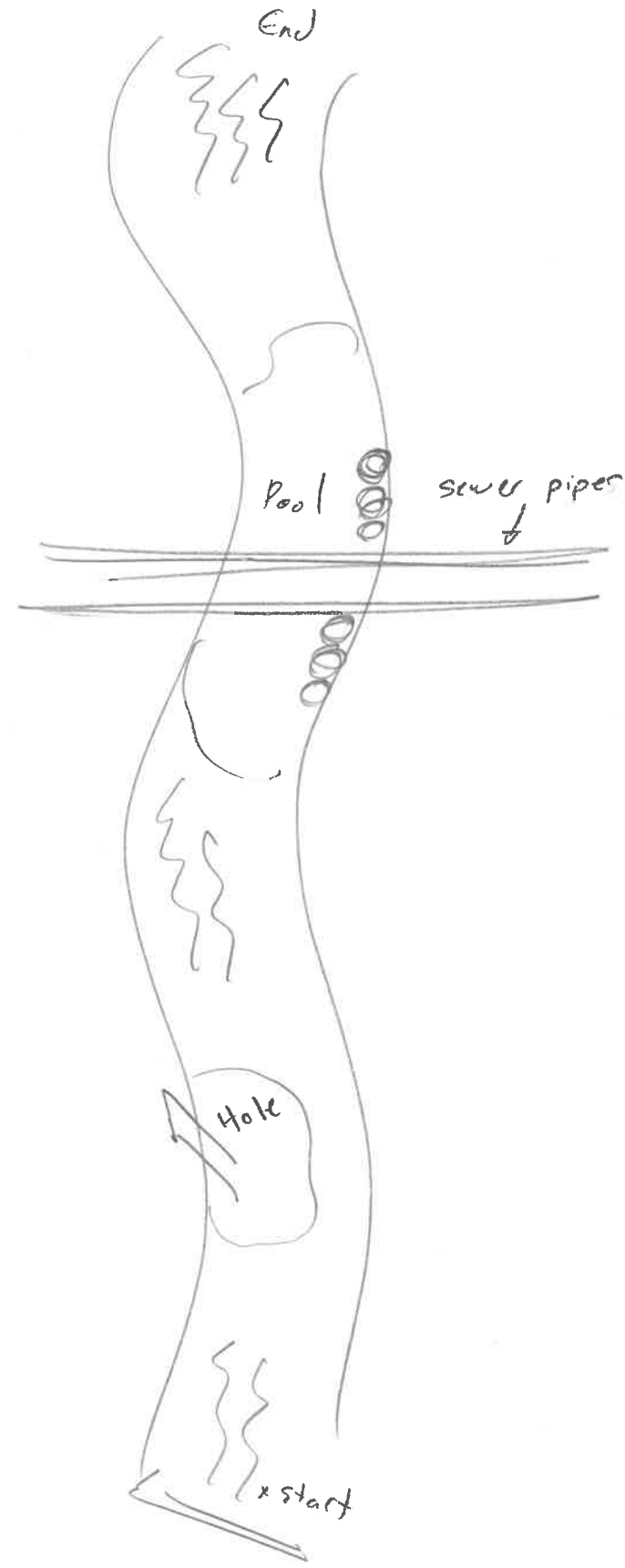
CJ RECREATION

- AREA
- DEPTH
- POOL: >100ft? >3ft

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

Sewage smell is present when breeze is not blowing

Stream Drawing:



Stream & Location: Tributary to Olentangy River @ Rt 245 Ust Confluence w/ Olentangy RM: 0.2 Date: 7/11/2022

BMR01 (Bill Mouse Run) Scorers Full Name & Affiliation: MAS - MBI River Code: 02-440- STORET #: Lat./Long.: 46 183 Office verified location

25
39
64
26
90
27

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. Check ONE (Or 2 & average). BEST TYPES: BLDR /SLABS [10], BOULDER [9], COBBLE [8], GRAVEL [7], SAND [6], BEDROCK [5]. OTHER TYPES: HARDPAN [4], DETRITUS [3], MUCK [2], SILT [2], ARTIFICIAL [0]. ORIGIN: LIMESTONE [1], TILLS [1], WETLANDS [0], HARDPAN [0], SANDSTONE [0], RIP/RAP [0], LACUSTURINE [0], SHALE [-1], COAL FINES [-2]. QUALITY: HEAVY [-2], MODERATE [-1], NORMAL [0], FREE [1], EXTENSIVE [-2], MODERATE [-1], NORMAL [0], NONE [1].

Substrate
18.5
Maximum
20

117

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts. AMOUNT: EXTENSIVE >75% [11], MODERATE 25-75% [7], SPARSE 5-<25% [3], NEARLY ABSENT <5% [1].

Cover
Maximum
20
14

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). SINUOSITY: HIGH [4], MODERATE [3], LOW [2], NONE [1]. DEVELOPMENT: EXCELLENT [7], GOOD [5], FAIR [3], POOR [1]. CHANNELIZATION: NONE [6], RECOVERED [4], RECOVERING [3], RECENT OR NO RECOVERY [1]. STABILITY: HIGH [3], MODERATE [2], LOW [1].

Channel
Maximum
20
11

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). EROSION: NONE / LITTLE [3], MODERATE [2], HEAVY / SEVERE [1]. RIPARIAN WIDTH: WIDE > 50m [4], MODERATE 10-50m [3], NARROW 5-10m [2], VERY NARROW < 5m [1], NONE [0]. FLOOD PLAIN QUALITY: FOREST, SWAMP [3], SHRUB OR OLD FIELD [2], RESIDENTIAL, PARK, NEW FIELD [1], FENCED PASTURE [1], OPEN PASTURE, ROWCROP [0]. CONSERVATION TILLAGE [1], URBAN OR INDUSTRIAL [0], MINING / CONSTRUCTION [0].

Riparian
Maximum
10
6

5] POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH: > 1m [6], 0.7-<1m [4], 0.4-<0.7m [2], 0.2-<0.4m [1], < 0.2m [0]. CHANNEL WIDTH: POOL WIDTH > RIFFLE WIDTH [2], POOL WIDTH = RIFFLE WIDTH [1], POOL WIDTH < RIFFLE WIDTH [0]. CURRENT VELOCITY: TORRENTIAL [-1], VERY FAST [1], FAST [1], MODERATE [1], SLOW [1], INTERSTITIAL [-1], INTERMITTENT [-2], EDDIES [1].

Recreation Potential
Primary Contact
Secondary Contact
Pool / Current
Maximum
12
5

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). NO RIFFLE [metric=0]. RIFFLE DEPTH: BEST AREAS > 10cm [2], BEST AREAS 5-10cm [1], BEST AREAS < 5cm [metric=0]. RUN DEPTH: MAXIMUM > 50cm [2], MAXIMUM < 50cm [1]. RIFFLE / RUN SUBSTRATE: STABLE [2], MOD. STABLE [1], UNSTABLE [0]. RIFFLE / RUN EMBEDDEDNESS: NONE [2], LOW [1], MODERATE [0], EXTENSIVE [-1].

Riffle / Run
Maximum
8
6

6] GRADIENT (24.4 ft/mi) DRAINAGE AREA (2.69 mi^2) VERY LOW - LOW [2-4], MODERATE [6-10], HIGH - VERY HIGH [10-6]. %POOL: %GLIDE: %RUN: %RIFFLE:

Gradient
Maximum
10
10

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

A) SAMPLED REACH
Check ALL that apply

METHOD

- BOAT
- WADE
- L. LINE
- OTHER

STAGE

- 1st - sample pass-- 2nd
- HIGH
- UP
- NORMAL
- LOW
- DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- < 20 cm
- 20-<40 cm
- 40-70 cm
- > 70 cm/ CTB
- SECCHI DEPTH

meters

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%-CLOSED

B) AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

C) RECREATION

AREA DEPTH

POOL: >100ft² >3ft

D) MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMoured / SLUMPS
- ISLANDS / SCoured
- IMPounded / DESICCATED
- FLOOD CONTROL / DRAINAGE

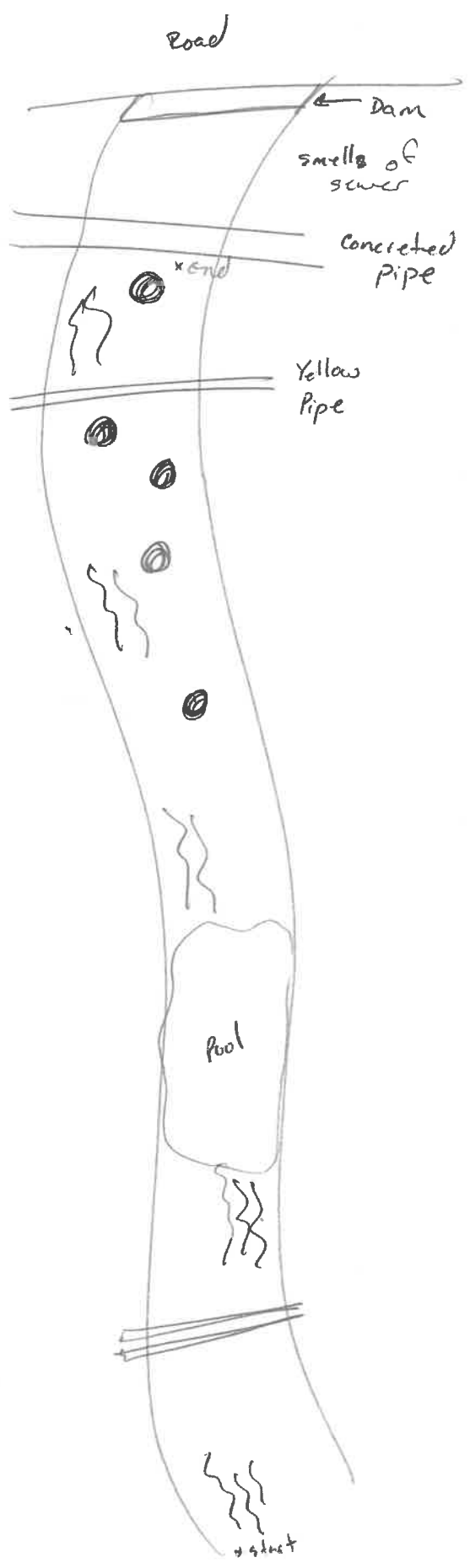
E) ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

F) MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone \bar{x}^2 width
- entrench. ratio

Legacy Tree:



Stream Drawing:

Stream & Location: Wahalla Hollow (Ravine) adj. Wahalla Rd. RM: 1.0 Date: 7/5/2022

WAH01 Scorers Full Name & Affiliation: MAS-MBI River Code: 02-439 STORET#: Lat./Long.: 40 183 Office verified location

1) SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present

Substrate assessment table with categories: BEST TYPES, OTHER TYPES, ORIGIN, and QUALITY. Includes handwritten marks and a circled score of 16.

2) INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts

Instream Cover assessment table with categories: UNDERCUT BANKS, OVERHANGING VEGETATION, SHALLOWS, ROOTMATS, POOLS, ROOTWADS, BOULDERS, OXBOWS, BACKWATERS, AQUATIC MACROPHYTES, LOGS OR WOODY DEBRIS. Includes handwritten marks and a circled score of 7.

3) CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average)

Channel Morphology assessment table with categories: SINUOSITY, DEVELOPMENT, CHANNELIZATION, STABILITY. Includes handwritten marks and a circled score of 11.

4) BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average)

Bank Erosion and Riparian Zone assessment table with categories: EROSION, RIPARIAN WIDTH, FLOOD PLAIN QUALITY, CONSERVATION TILLAGE, URBAN OR INDUSTRIAL, MINING / CONSTRUCTION. Includes handwritten marks and a circled score of 5.

5) POOL / GLIDE AND RIFFLE / RUN QUALITY

Pool / Glide and Riffle / Run Quality assessment table with categories: MAXIMUM DEPTH, CHANNEL WIDTH, CURRENT VELOCITY, Recreation Potential. Includes handwritten marks and a circled score of 4.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average)

Riffle / Run Quality assessment table with categories: RIFFLE DEPTH, RUN DEPTH, RIFFLE / RUN SUBSTRATE, RIFFLE / RUN EMBEDDEDNESS. Includes handwritten marks and a circled score of 0.

6) GRADIENT (52.6 ft/mi) DRAINAGE AREA (1.13 mi^2) %POOL: %GLIDE: %RUN: %RIFFLE: Gradient Maximum 10

Handwritten numbers on the left margin: 14, 15, 29, 17, 46, 11, 57, 20, 77, 12, 89, 16, 05, 10, 115

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/Sampling observations, Concerns, Access directions, etc.

AJ SAMPLED REACH
Check ALL that apply

METHOD
 BOAT
 WADE
 LINE
 OTHER

STAGE
 1st -sample pass- 2nd
 HIGH
 UP
 NORMAL
 LOW
 DRY

DISTANCE
 0.5 Km
 0.2 Km
 0.15 Km
 0.12 Km
 OTHER

CLARITY
 1st -sample pass- 2nd
 < 20 cm
 20-40 cm
 40-70 cm
 > 70 cm/CTB
 SECCHI DEPTH

CANOPY 1st _____ cm
 2nd _____ cm

CJ RECREATION AREA DEPTH
 >100ft² >3ft
 <10% CLOSED

BJAESTHETICS

NUISANCE ALGAE
 INVASIVE MACROPHYTES
 EXCESS TURBIDITY
 DISCOLORATION
 FOAM / SCUM
 OIL SHEEN
 TRASH / LITTER
 NUISANCE ODOR
 SLUDGE DEPOSITS
 CSOs/SSOs/OUTFALLS

DJ MAINTENANCE
 PUBLIC / PRIVATE / BOTH / NA
 ACTIVE / HISTORIC / BOTH / NA
 YOUNG-SUCCESSION-OLD
 SPRAY / SNAG / REMOVED
 MODIFIED / DIPPED OUT / NA
 LEVEED / ONE SIDED
 RELOCATED / CUTOFFS
 MOVING-BEDLOAD-STABLE
 ARMoured / SLUMPS
 ISLANDS / SCoured
 IMPOUNDED / DESICCATED
 FLOOD CONTROL / DRAINAGE

Circle some & COMMENT

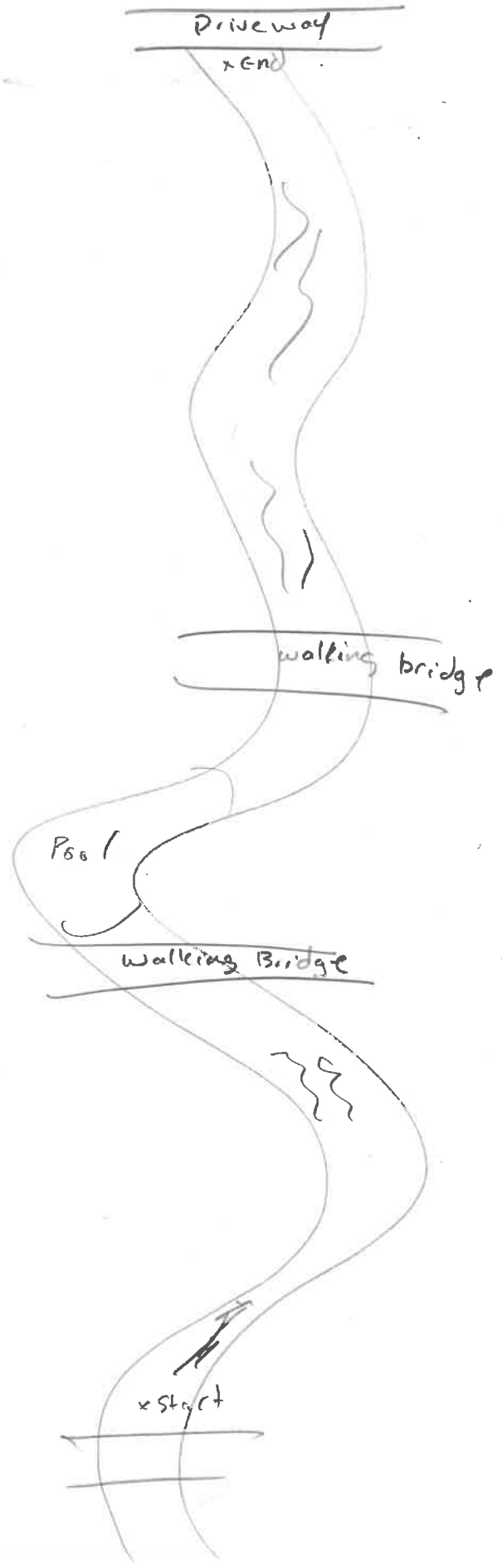
EJ ISSUES

WWTP / CSO / NPDES / INDUSTRY
 HARDENED / URBAN / DIRT&GRIME
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 PARK / GOLF / LAWN / HOME
 ATMOSPHERE / DATA PAUCITY

FJ MEASUREMENTS

\bar{x} width
 \bar{x} depth
 max. depth
 \bar{x} bankfull width
 bankfull \bar{x} depth
 W/D ratio
 bankfull max. depth
 floodprone \bar{x}^2 width
 entrench. ratio
 Legacy Tree:

Stream Drawing:



APPENDIX D-3: Olentangy River Tributary HHEI Field Sheets 2022



Headwater Habitat Evaluation Index Field Form

HHEI Score (sum of metrics 1+2+3)

86

SITE NAME/LOCATION Linworth Run
 SITE NUMBER LEND RIVER BASIN Olethaung RIVER CODE _____ DRAINAGE AREA (m²) 2.52
 LENGTH OF STREAM REACH (ft) 200 LAT 40.0929 LONG -83.0497 RIVER MILE 0.90
 DATE 06/24/22 SCORER ARK COMMENTS _____

NOTE: Complete All Items On This Form - Refer to "Headwater Habitat Evaluation Index Field Manual" for instructions

STREAM CHANNEL MODIFICATIONS: NONE / NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY

1. SUBSTRATE (Estimate percent of every type present) Check ONLY two predominant substrate TYPE boxes. (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B		HHEI Metric Points Substrate Max = 40 <div style="border: 1px solid black; padding: 5px; width: 40px; text-align: center; margin: 10px auto;">36</div> A + B																											
<table border="0"> <thead> <tr> <th>TYPE</th> <th>PERCENT</th> <th>TYPE</th> <th>PERCENT</th> </tr> </thead> <tbody> <tr> <td><input type="checkbox"/> BLDR SLABS [16 pts]</td> <td style="text-align: center;"><u>9</u></td> <td><input type="checkbox"/> SILT [3 pt]</td> <td style="text-align: center;"><u>1.5</u></td> </tr> <tr> <td><input checked="" type="checkbox"/> BOULDER (>256 mm) [16 pts]</td> <td style="text-align: center;"><u>20</u></td> <td><input type="checkbox"/> LEAF PACK/WOODY DEBRIS [3 pts]</td> <td style="text-align: center;"><u>1.5</u></td> </tr> <tr> <td><input type="checkbox"/> BEDROCK [16 pts]</td> <td style="text-align: center;"><u>40</u></td> <td><input type="checkbox"/> FINE DETRITUS [3 pts]</td> <td style="text-align: center;"><u>2.5</u></td> </tr> <tr> <td><input checked="" type="checkbox"/> COBBLE (65-256 mm) [12 pts]</td> <td style="text-align: center;"><u>10</u></td> <td><input type="checkbox"/> CLAY or HARDPAN [0 pt]</td> <td style="text-align: center;"><u>2.5</u></td> </tr> <tr> <td><input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]</td> <td style="text-align: center;"><u>10</u></td> <td><input type="checkbox"/> MUCK [0 pts]</td> <td style="text-align: center;"><u> </u></td> </tr> <tr> <td><input type="checkbox"/> SAND (<2mm) [6 pts]</td> <td style="text-align: center;"><u> </u></td> <td><input type="checkbox"/> ARTIFICIAL [3 pts]</td> <td style="text-align: center;"><u> </u></td> </tr> </tbody> </table>	TYPE		PERCENT	TYPE	PERCENT	<input type="checkbox"/> BLDR SLABS [16 pts]	<u>9</u>	<input type="checkbox"/> SILT [3 pt]	<u>1.5</u>	<input checked="" type="checkbox"/> BOULDER (>256 mm) [16 pts]	<u>20</u>	<input type="checkbox"/> LEAF PACK/WOODY DEBRIS [3 pts]	<u>1.5</u>	<input type="checkbox"/> BEDROCK [16 pts]	<u>40</u>	<input type="checkbox"/> FINE DETRITUS [3 pts]	<u>2.5</u>	<input checked="" type="checkbox"/> COBBLE (65-256 mm) [12 pts]	<u>10</u>	<input type="checkbox"/> CLAY or HARDPAN [0 pt]	<u>2.5</u>	<input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]	<u>10</u>	<input type="checkbox"/> MUCK [0 pts]	<u> </u>	<input type="checkbox"/> SAND (<2mm) [6 pts]	<u> </u>	<input type="checkbox"/> ARTIFICIAL [3 pts]	<u> </u>
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This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY * NOTE: River Left (L) and Right (R) as looking downstream.

RIPARIAN WIDTH (Per Bank)

L	R	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Wide >10m
<input type="checkbox"/>	<input type="checkbox"/>	Moderate 5-10m
<input type="checkbox"/>	<input type="checkbox"/>	Narrow <5m
<input type="checkbox"/>	<input type="checkbox"/>	None

FLOODPLAIN QUALITY (Most Predominant per Bank)

L	R		L	R	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Mature Forest, Wetland	<input type="checkbox"/>	<input type="checkbox"/>	Conservation Tillage
<input type="checkbox"/>	<input type="checkbox"/>	Immature Forest, Shrub or Old Field	<input type="checkbox"/>	<input type="checkbox"/>	Urban or Industrial
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Residential, Park, New Field	<input type="checkbox"/>	<input type="checkbox"/>	Open Pasture, Row Crop
<input type="checkbox"/>	<input type="checkbox"/>	Fenced Pasture	<input type="checkbox"/>	<input type="checkbox"/>	Mining or Construction

COMMENTS _____

FLOW REGIME (At Time of Evaluation) (Check ONLY one box):

 Stream Flowing Moist Channel, isolated pools, no flow (intermittent)
 Subsurface flow with isolated pools (interstitial) Dry channel, no water (ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

<input checked="" type="checkbox"/> None	<input type="checkbox"/> 1.0	<input type="checkbox"/> 2.0	<input type="checkbox"/> 3.0
<input type="checkbox"/> 0.5	<input type="checkbox"/> 1.5	<input type="checkbox"/> 2.5	<input type="checkbox"/> >3

STREAM GRADIENT ESTIMATE

Flat (0.5 ft/100 ft) Flat to Moderate Moderate (2 ft/100 ft) Moderate to Severe Severe (10 ft/100 ft)

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? Yes No QHEI Score _____ (If Yes, Attach Completed QHEI form)

DOWNSTREAM DESIGNATED USE(S)

WWH Name: Olethoxy Distance from Evaluated Stream 0.9 miles
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION.

USGS Quadrangle Name: _____ NRCS Soil Map Page: _____ NRCS Soil Map Stream Order: _____
 County: Franklin Township/City: Linworth

MISCELLANEOUS

Base Flow Conditions? (Y/N): Y Date of last precipitation: 9 days prior Quantity: less than .5 inch

Photo-documentation Notes: Green Camera

Elevated Turbidity? (Y/N): N Canopy (% open): 0% open

Were samples collected for water chemistry? (Y/N): Y Lab Sample # or ID (attach results): _____

Field Measures: Temp (°C) 18.5°C Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (umhos/cm) _____

Is the sampling reach representative of the stream (Y/N) Y If not, explain: _____

Additional comments/description of pollution impacts: Storm Water influence
(Two) 2 Salamander larvae collected during surveying time of 30

BIOLOGICAL OBSERVATIONS
 (Record all observations below)

Fish Observed? (Y/N) Y Species observed (if known): Creek Chub Midstate S. class IIIA primary headwater.

Frogs or Tadpoles Observed? (Y/N) N Species observed (if known): _____

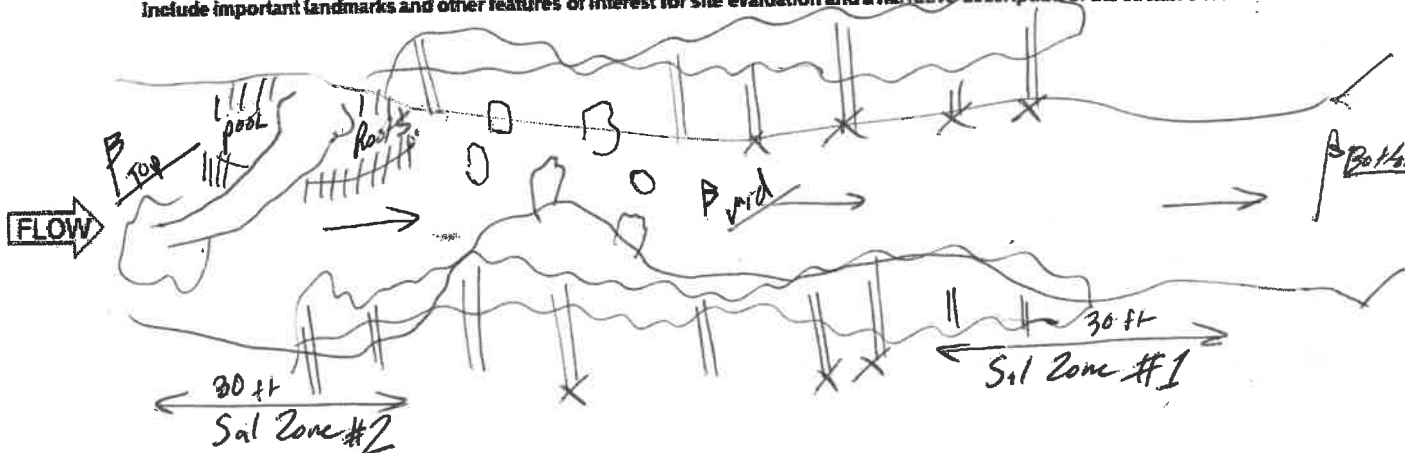
Salamanders Observed? (Y/N) Y Species observed (if known): Southern Two lined Salamander

Aquatic Macroinvertebrates Observed? (Y/N) Y Species observed (if known): Hydrogenidae

Comments Regarding Biology: It seems like fish are the top predator in this stream with a max pool of 45cm.

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed)

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location





Headwater Habitat Evaluation Index Field Form

HHEI Score (sum of metrics 1+2+3)

84

SITE NAME/LOCATION Wathalla Hollow
 SITE NUMBER WAHDI RIVER BASIN Ontario RIVER CODE _____ DRAINAGE AREA (mi²) _____
 LENGTH OF STREAM REACH (ft) 200ft LAT 41.02760 LONG 083.00564 RIVER MILE _____
 DATE 06/21 SCORER APK COMMENTS Channelized Stream Along Road

NOTE: Complete All Items On This Form - Refer to "Headwater Habitat Evaluation Index Field Manual" for instructions

STREAM CHANNEL MODIFICATIONS: NONE / NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY

1. SUBSTRATE (Estimate percent of every type present). Check ONLY two predominant substrate TYPE boxes. (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.				HHEI Metric Points Substrate Max = 40 <div style="border: 1px solid black; padding: 5px; text-align: center; font-size: 24px;">29</div>																											
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SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: <u>21</u> TOTAL NUMBER OF SUBSTRATE TYPES: <u>8</u>																															
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COMMENTS <u>5m 4m 3.5m 4.16m</u>		AVERAGE BANKFULL WIDTH (meters) <u>30</u>																													

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY * NOTE: River Left (L) and Right (R) as looking downstream.

RIPARIAN WIDTH (Per Bank)		FLOODPLAIN QUALITY (Most Predominant per Bank)	
L	R	L	R
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

COMMENTS _____

FLOW REGIME (At Time of Evaluation) (Check ONLY one box):

Stream Flowing Moist Channel, isolated pools, no flow (intermittent)
 Subsurface flow with isolated pools (interstitial) Dry channel, no water (ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

None 1.0 2.0 3.0
 0.5 1.5 2.5 >3

STREAM GRADIENT ESTIMATE

Flat (0.5 ft/100 ft) Flat to Moderate Moderate (2 ft/100 ft) Moderate to Severe Severe (10 ft/100 ft)

ADDITIONAL STREAM INFORMATION (This information Must Also be Completed):

QHEI PERFORMED? Yes No QHEI Score _____ (If Yes, Attach Completed QHEI form)

DOWNSTREAM DESIGNATED USE(S)

WWH Name: Oleontangy Water Street/Power Distance from Evaluated Stream 10 miles +/- 5 miles
 CWH Name: _____ Distance from Evaluated Stream _____
 EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION.

USGS Quadrangle Name: _____ NRCS Soil Map Page: _____ NRCS Soil Map Stream Order: _____
 County: Franklin Township/City: _____

MISCELLANEOUS

Base Flow Conditions? (Y/N): Y Date of last precipitation: 4 days prior Quantity: less than 1 inch
 Photo-documentation Notes: Green Camera
 Elevated Turbidity? (Y/N): N Canopy (% open): 10% open
 Were samples collected for water chemistry? (Y/N): Y Lab Sample # or ID (attach results): _____
 Field Measures: Temp (°C) 21.7°C Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____
 Is the sampling reach representative of the stream (Y/N) Y If not, explain: _____

Additional comments/description of pollution impacts: This is a receding stream in a very Urban/mature forested Area. Stream is channelized Along Road.

BIOLOGICAL OBSERVATIONS

(Record all observations below)

Fish Observed? (Y/N) Y Species observed (if known): Creek Chub
 Frogs or Tadpoles Observed? (Y/N) N Species observed (if known): _____
 Salamanders Observed? (Y/N) N Species observed (if known): _____
 Aquatic Macroinvertebrates Observed? (Y/N) Y Species observed (if known): Oligochaeta
 Comments Regarding Biology: No Salamanders Observed or Collected. 45 minute VES Done in All available habitat

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed)

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location

