Midwest Biodiversity Institute, Inc.
P.O. Box 21561
Columbus, OH 43221-0561

To: Laura Boyd, Environmental Manager, MSDGC

From: Chris Yoder, Research Director, MBI

Subject: Technical Memorandum: Lower Mill Creek Partial Bioassessment – Follow-up to Sewage Releases of March 2023

Date: July 17, 2024

In March 2023, the Mill Creek wastewater treatment plant (WWTP) suffered a complete power loss that resulted in releases of raw and partially treated sewage to the lower reaches of Mill Creek over six (6) days. To evaluate for any long term impacts, MSD tasked MBI with assessing the status of aquatic life and water quality in the lower 5.1 miles of the Mill Creek mainstem between Salway Park and the mouth of the Mill Creek during the seasonal index period of June 15-October 15, 2023. Details of this assessment are presented herein. Overall, the assessment found that there was no appreciable decline in the longitudinal pattern in three biological indices and that despite any short-term impact, the trajectory of steadily improving conditions that has been observed since 1992 in lower Mill Creek was not altered.

Overview

The Metropolitan Sewer District of Greater Cincinnati's (MSDGC) Mill Creek WWTP lost all electrical power on March 5, 2023 following the catastrophic failure of a new high-voltage transformer installed at the Mill Creek electric substation as part of a $17.5 million upgrade project. Without power to the WWTP, untreated and partially treated wastewater was discharged into lower Mill Creek and the Ohio River. Temporary power was restored on March 8, 2023 using diesel-powered generators and the resulting overflows ended on March 10th. On March 16, 2023, full power was restored after reconnecting to the Duke Energy electrical grid.

The releases occurred to the lower reach of Mill Creek via multiple combined sewer overflows and a manhole cover that persisted for six (6) days. The releases extended approximately 3.5 miles upstream on Mill Creek to the West Fork confluence. While there were no immediate impacts such as fish kills, the flow of raw and partially treated sewage during the power outage was visible (Figure 1). Concern about the extent and lasting effects was expressed by an important stakeholder group, the Mill Creek Alliance (MCA). MCA requested that a biological survey be conducted in the Mill Creek mainstem that was directly affected by the power outage related releases. MSDGC agreed and funded the sampling of nine (9) sites for fish and six (6) sites for macroinvertebrates consistent with the CSO permit biological monitoring that has been conducted by MSDGC since 2011[1].

[1] Find the 2011-2021 MSDGC bioassessments at: http://www.msdgc.org/initiatives/water_quality/index.html.

***Figure 1**. Photo of a sewage plume entering Mill Creek from a manhole in West Fork Creek at the Mill Creek Rd. Yellow Bridge (RM 3.3) during the Mill Creek WWTP power outage in March 2023.*

The most recent biological survey of Mill Creek was conducted in 2021 and it was preceded by surveys in 2011, 2013, and 2016. Trend analysis was conducted for each survey year and included prior Ohio EPA surveys dating back to 1992. The established methods of trend assessment were applied to the 2023 results in order to determine if any significant declines occurred as a possible result of the unintended releases due to the power outage. Incremental improvements have been observed since 2011 in the Mill Creek mainstem biota so any interruptions in this progress are of major concern. As with all prior MSDGC sponsored biological surveys, the 2023 survey was performed by Level 3 Qualified Data Collectors under a Biological and Water Quality Project Study Plan (MBI 2023) approved by Ohio EPA under the specifications of the Ohio Credible Data Law.

Monitoring Design and Methods

A biological assessment consisting of fish and habitat sampling and deployment of artificial substrates for macroinvertebrates was accomplished during the June 16-October 15 seasonal index period in 2023. An intensive pollution survey design that employs a high density of sampling sites and biological, chemical, and physical indicators and parameters was followed in 2023. The principal objectives of the biological assessment are to report aquatic life and recreational use attainment status, following the Ohio WQS and Ohio EPA practices, and determine associated causes and sources of impairment. To accomplish this, 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 Lower Mill Creek mainstem.

A total of nine (9) sites that were sampled as part of the prior surveys of Mill Creek were sampled in 2023 (Table 1). Fish, macroinvertebrates, habitat, simple water chemistry, and sediment chemistry samples were collected during the summer-fall index period of June 16-October 15, 2023 to assess for any lingering effects from the March 2023 release of raw and partially treated sewage. The sites matched those sampled previously by MBI for the MSDGC

instream monitoring rotation. Macroinvertebrates were not collected at the three (3) sites influenced by the Ohio River backwater in Mill Creek. Sampling within the same seasonal index period as prior surveys standardized the comparison between years, which is the protocol for determining if any adverse effects lingered after the March 2023 releases.

Characterization of Short-Term Sewage Releases

An estimate of the magnitude of discharges from specific sources via which the release of raw and partially treated wastewater reached Mill Creek is depicted in Figure 2. MSDGC continuously monitors flows in their sewage system including discharges from CSOs. Thus, data was available during the period of unintentional releases of sewage to surface water to gain an understanding about which sources were the largest contributors. According to data provided by MSDGC overflows occurred at 11 CSOs for a total estimated volume of 438.9 MG. Of this total volume about 42% was from CSO 004 (Mill Creek RM 0.51). CSOs 428 (Mill Creek RM 0.30), 152 (Mill Creek RM 0.52), and 419 (Ohio R.) contributed an additional 49.6%. All of the CSOs in Figure 2 discharge to the lower three miles of Mill Creek and directly to the Ohio River. The sewage plume substantially visible in Figure 1 is from a manhole in the lower 0.15 miles of West Fork Creek. Figure 3 shows the locations of the CSOs, the West Fork Creek manhole (MH-29609025), the Mill Creek WWTP, and the location of sampling sites relative to these sources. The raw and partially treated sewage releases occurred in the lower three miles of the Mill Creek mainstem.

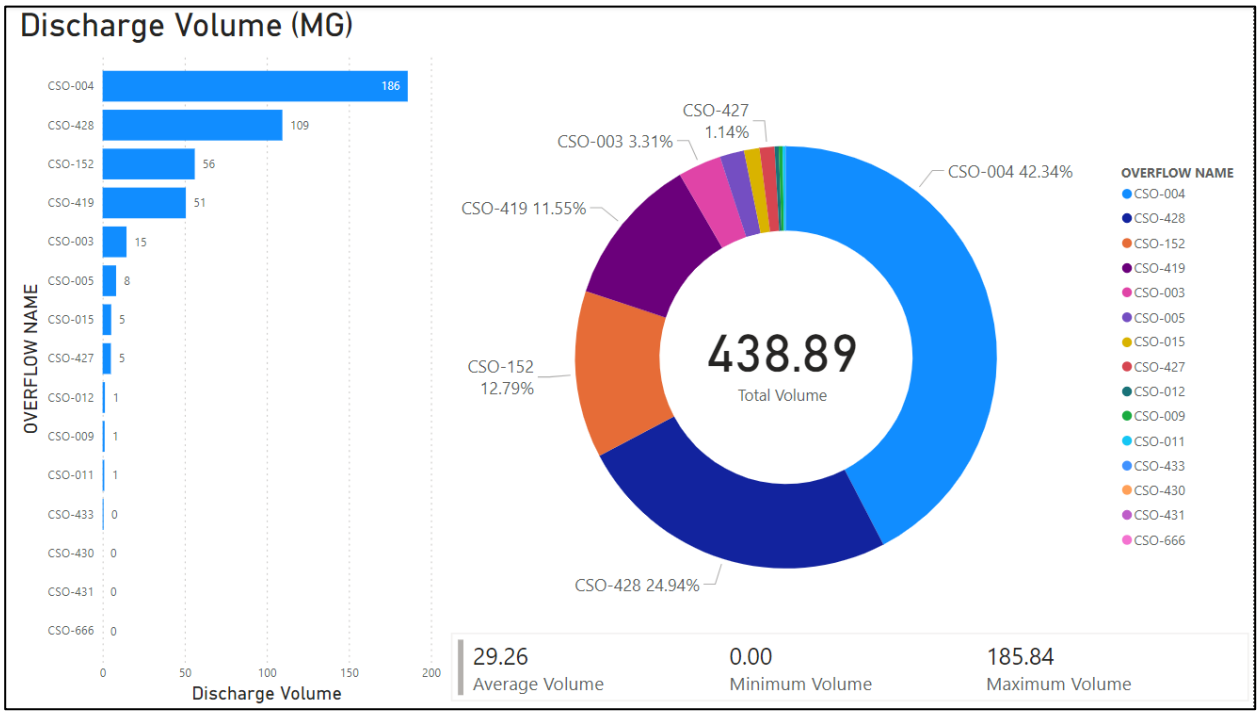


***Figure 2**. An estimate of CSO flows associated with the March 2023 power outage.*

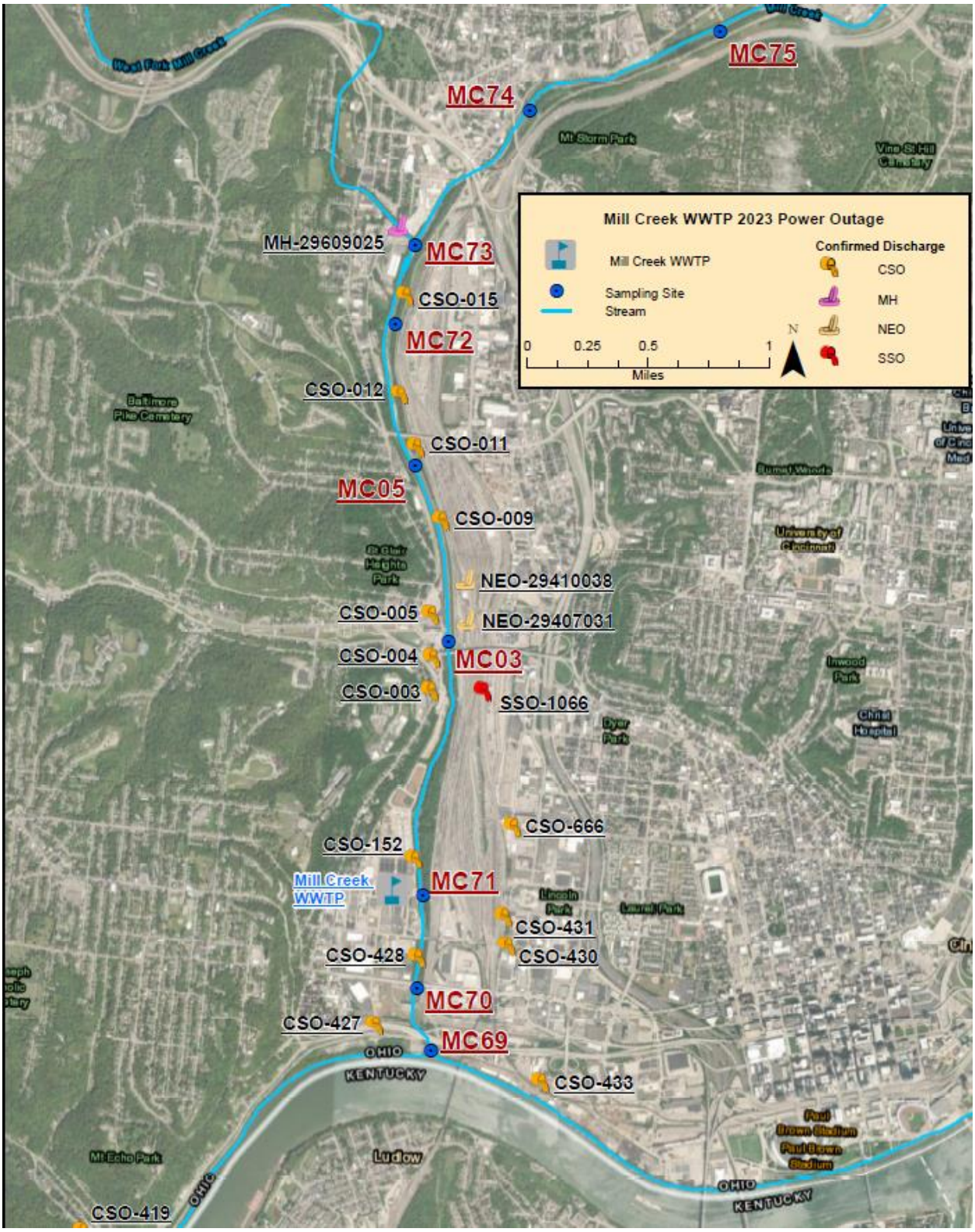


***Figure 3**. The reach of Lower Mill Creek upstream and downstream from the March 2023 power outage related releases of raw and partially treated sewage in proximity to sites sampled during July-September 2023.*

***Table 1**. List of sites sampled during June 16-October 15, 2023 in lower Mill Creek for fish, macroinvertebrates, habitat, simple water chemistry, and sediment chemistry as a follow-up to sewage releases in March 2023 (P – raft electrofishing; HD – Hester-Dendy artificial substrate; na – not applicable).*

Site ID	Stream Name	Latitude	Longitude	River Mile	Location-Description	Drain. Area (sq. mi.)	Fish	Macroin-vertebrates	Habitat	Field Chem.	Sed. Metals	Sed. Organics
Mill Creek Mainstem												
MC75	Mill Creek	39.162200	-84.523300	5.10	Adj. Salway Park	136	P	HD	QHEI	2X	1X	1X
MC74	Mill Creek	39.157210	-84.537830	4.25	Ust. S. Ludlow Ave, bridge	141	P	HD	QHEI	2X	1X	1X
MC73	Mill Creek	39.148960	-84.546420	3.50	Ust. Mill Creek Rd.	154	P	HD	QHEI	2X	1X	1X
MC72	Mill Creek	39.144200	-84.547800	3.10	Dst. Mill Creek Rd.	155	P	HD	QHEI	2X	1X	1X
MC05	Mill Creek	39.135720	-84.546027	2.50	Dst. Hopple Street bridge	154	P	HD	QHEI	2X	1X	1X
MC03	Mill Creek	39.125235	-84.543167	1.70	Dst. Lick Run CSO (005)	163	P	HD	QHEI	2X	1X	1X
MC71	Mill Creek	39.110000	-84.544700	0.70	Ust. Gest Street bridge	165	P	na	QHEI	2X	1X	1X
MC70	Mill Creek	39.104400	-84.545000	0.30	Dst. Mill Creek WWTP	165	P	na	QHEI	2X	1X	1X
MC69	Mill Creek	39.100680	-84.543820	0.05	R.R. trestle - Queensgate	166	P	na	QHEI	2X	1X	1X

Results and Discussion

The data collected in 2023 was subjected to the same analyses of biological assemblage level results as the prior assessments of the Mill Creek mainstem performed in 2011, 2013, 2016, and 2021. The comparison of the 2023 results was truncated to the reach between Salway Park at site MC75 (RM 5.1) and the mouth at site MC69 (RM 0.05). Limited water chemistry was collected with the fish sampling and the results appear in Appendix A. Sediment chemistry was also collected and is also included in Appendix A.

The biological assessment included an aquatic life use attainment table, a trend analysis of Area of Attainment and Area of Degradation and Values (AAV/ADV)[2] and miles attaining and not attaining the applicable Modified Warmwater Habitat (MWH) use designation, and longitudinal graphs of the fish Index of Biotic Integrity, Modified Index of Well-Being (MIwb), the Invertebrate Community Index (ICI) for macroinvertebrates, and the Qualitative Habitat Evaluation Index (QHEI). Fish metrics and species by site and sample appear in Appendix B, macroinvertebrate metrics and taxa by site appear in Appendix C, and habitat metrics and field sheets are included in Appendix D.

Aquatic Life Use Attainment Status

Aquatic life use attainment status was determined using the biological index scores for fish and macroinvertebrates per Ohio EPA guidelines and using the numeric biological criteria codified in the Ohio WQS. The results were judged against the Modified Warmwater Habitat (MWH-C) use designation for channelization that applies in the lower 7.5 miles of Mill Creek. The two (2) upstream sites were in partial attainment of MWH-C due to a low MIwb at MC75 and a low ICI at MC74. Both sites were in full attainment of MWH-C in 2021. The remaining sites were all in full attainment the same as in 2021 with the exception of MC03 downstream from Lick Run which was in partial attainment in 2021 due to a low ICI.

Trends in Biological Indices

The longitudinal trends in the primary biological indices were similar to that observed in Lower Mill Creek in the prior mainstem biological assessments dating back to 2011. The fish Index of Biotic Integrity (IBI) generally followed the same pattern as in 2011 and 2021. An exception was the mean of two passes attaining the WWH IBI biocriterion of 40 in 2023 at three (3) sites, MC 74 (RM 4.30), MC 73 (RM 3.50), and MC 72 (RM 3.10) the latter site of which is immediately downstream from the West Fork Creek confluence (Figure 3). IBI values declined at MC05 (RM 2.50) and downstream, but still met the MWH-C biocriterion at all sites. The lowest IBI of 26 occurred at the upstream site MC 75 (RM 5.10) at Saylor Park which is upstream of the reach directly affected by the March 2023 sewage releases. The MIwb showed an overall increase downstream similar to the 2011, 2016, and 2021 results (Figure 3). The MIwb at sites MC74 (RM 4.30), MC03 (RM 1.70), and MC71 (RM 0.70) all met the WWH MIwb biocriterion. The remaining sites met the MWH-C biocriterion except for the upstream most site MC 75 (RM 5.10) at Saylor Park which failed to meet the MIwb biocriterion resulting in partial

[2] Please refer to the 2016 or 2021 reports for additional descriptions of the AAV, ADV, and AAV/ADV.

attainment (Table 2).

The macroinvertebrate ICI also showed a general similarity to prior results in 2016 and 2021 (Figure 3). The WWH ICI biocriterion was met at three (3) consecutive sites in 2023, MC73 (RM 3.50), MC72 (RM3.10), and MC05 (RM 1.70). The prevailing MWH-C biocriterion was met at two (2) of the remaining three sites, failing to meet the biocriterion at MC74 (RM74 (RM 4.30) resulting in partial attainment of MWH (Table 2). The lower three (3) sites were not sampled for macroinvertebrates due to the slow current in the modified Ohio River backwater habitat as has been the case since 2011.

Habitat as measured by the QHEI showed a longitudinal pattern similar to prior years 2016 and 2021, which represent improvements since 1992 and 2011 presumably due to natural recovery processes within the portions of the stream channel that are not constrained by concrete features (Figure 3). The QHEI value of 71.8 at MC74 (RM 4.30) represents very good quality habitat while the QHEI of 60.0 at MC03 (RM 1.70) is good quality. The remaining QHEI values ranged mostly from 53.5-55.0 which is upper fair quality and a QHEI of 48.0 at MC05 (RM 1.70) which at fair was the lowest quality habitat in the lower mainstem in 2023. While habitat has improved measurably since 2011, QHEI scores still reflect the legacy effects of prior channelization including extensive concrete sloped banks along the length of most of the lower mainstem.

Trajectories in Biological Indicators

The results of the 1992-2023 bioassessments, using the primary indices that comprise the Ohio biocriteria, have been used to quantify the degree to which overall aquatic life conditions have improved through time up to and including the 2023 survey. The Area of Degradation (ADV) and Attainment (AAV) methodology was used herein to illustrate the degree of change between the Ohio EPA surveys of 1992, 2011, 2013, 2016, 2021, and 2023 Ohio EPA and MBI surveys of the lower mainstem of Mill Creek. The ADV/AAV term is an expression of the degree to which one of the biological index values is either above or below the MWH-C 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 including the severity of degradation. 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 through time.

The change in ADV/AAV results for the fish IBI, the MIwb, and the macroinvertebrate Invertebrate Community Index (ICI) between 1992 and 2023 indicates a substantial improvement in biological condition since 1992 and 2011 (Figure 4). In 1992, the ADV was significantly greater than subsequent years while the AAV was zero for all three indices. The ADV was also substantial to the near exclusion of an AAV for the ICI in 2011. Since 2016, the AAV has been positive for all three indices with the highest AAVs in 2021 for the IBI and ICI. A slight decline for the ICI AAV occurred in 2023, but was still higher than the first positive value observed in 2016. In terms of the miles of attainment and non-attainment of the MWH-C designated use in lower Mill Creek, full attainment was evident in most of the lower reach of Mill Creek for the first time in 2013. While localized sites of non-attainment remain, these

***Table 2**. Aquatic life use attainment status in the Modified Warmwater Habitat (MWH) designated Lower Mill Creek during July-October 2023. Attainment status is based on the MWH use biocriteria with location and proximity to CSOs and SSOs.*

Site ID	Fish/Macro River Mile	Drainage Area (sq. mi.)	Aquatic Life Use	Site Type	IBI	MIwb	ICI	AQLU Status	QHEI	Comments	Proximity to CSO/SSO
MC75	5.10/5.10	139.0	MWH-C	Wadeable	26	5.65*	26	PARTIAL	58.0	Salway Park - ust. releases	CSO 025, 026, 028, 030, 033, 480, 481, 482
MC74	4.30/4.30	141.0	MWH-C	Wadeable	40	7.51	20*	PARTIAL	71.8	Ust. S. Ludlow Ave.	CSO 022, 023, 024, 179
MC73	3.50/3.50	144.0	MWH-C	Wadeable	42	8.04	30	FULL	55.0	Ust. Mill Creek Rd. & West Fork Creek	
MC72	3.10/3.10	154.0	MWH-C	Wadeable	42	8.05	36	FULL	53.8	Dst. Mill Creek Rd. & releases via W. Fk. Cr.	CSO 015, 017, 018, 019, 021; 528, 529, 530
MC05	2.50/2.50	156.0	MWH-C	Wadeable	34	7.43	36	FULL	48.0	Dst. Hopple Street	CSO 010, 011, 012, 013, 014
MC03	1.70/1.70	163.0	MWH-C	Boatable	30	8.20	26	FULL	60.0	Dst. Lick Run CSO (005)	CSO 005 (Lick Run), 006, 007, 008, 009
MC71	0.70/0.65	165.0	MWH-C	Boatable	30	8.44		FULL	53.5	Ust. Gest Street bridge	CSO 152, 002, 003, 004, 666, SSO 1066
MC70	0.30/0.30	165.0	MWH-C	Boatable	28	8.19		FULL	55.0	Dst. Mill Creek WWTP	CSO 428, 429; MSDGC Mill Creek WWTP 001
MC69	0.10/0.10	164.0	MWH-C	Boatable	32	7.69		FULL	54.0	R.R. trestle - Queensgate	CSO 428, 429; MSDGC Mill Creek WWTP 001
Criteria and Narrative Thresholds			**Exceptional**		>50	>9.4	>48	FULL	>75		
			Good		>40	>8.5	>34	FULL	>60		
			Fair		>24	>5.9	>12	FULL/PARTIAL	>45		
			Poor		>18	>4.5	>6	PART. NON-POOR	>30		
			Very Poor		≤12	≤4.5	≤6	NON-V.POOR	≤30		

Footnotes: [a] - as codified in OAC 3745-1-07, Table 7-1; [b] - 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.

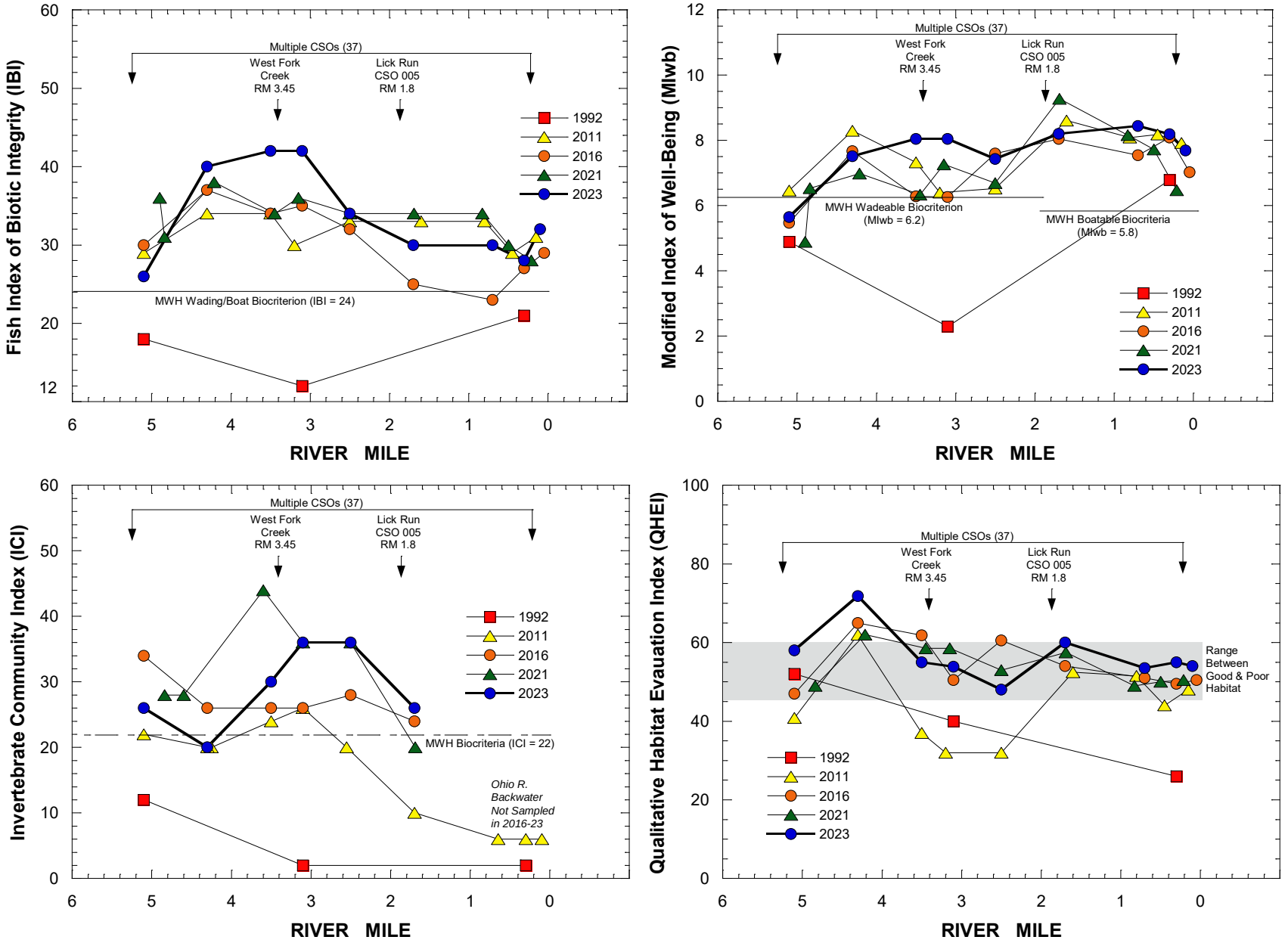


***Figure 4**. Longitudinal trend in the fish IBI, MIwb, macroinvertebrate ICI, and QHEI in Lower Mill Creek for all Ohio EPA and MBI survey years 1992-2023.*

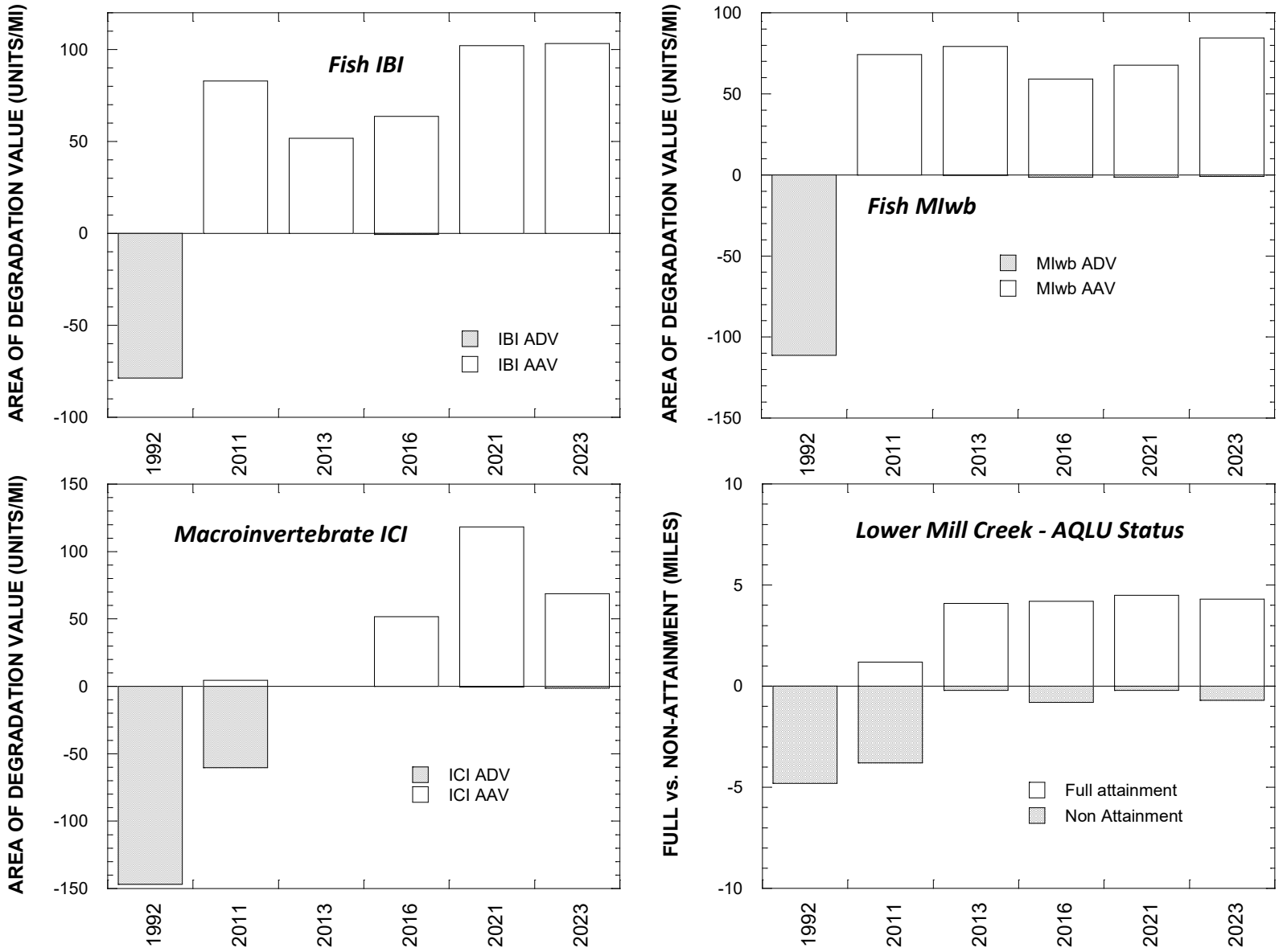


***Figure 5**. Area of Degradation (ADV) and Attainment (AAV) values for the fish IBI, MIwb, macroinvertberte ICI, and miles of aquatic Life use attainment status in Lower Mill Creek 1992-2023.*

results indicate a significant incremental improvement in the Mill Creek mainstem which reflects the cumulative effects of pollution abatement efforts over the previous three decades. The 2023 results were roughly comparable to 2016. Two (2) sites in partial attainment of MWH-C upstream from the impacted reach contributed to the slight increase in miles of non-attainment in 2023 compared to 2021.

Summary and Conclusions

The primary goal of the 2023 biological assessment of the Lower Mill Creek mainstem was to determine if there are any lingering adverse impacts from the March 2023 releases of raw and partially treated sewage that were caused by the power outage that occurred at the Mill Creek WWTP. Having the results of five (5) previous surveys, four (4) of which occurred over a 10-year span of time through 2021, was an important benefit in terms of drawing conclusions about the 2023 results. The 2023 results were judged not only against the biological criteria for the applicable MWH-C use designation, but the preceding surveys and the trajectory of recovery that has been documented since 1992. No appreciable decline in the longitudinal pattern in the three biological indices nor in the trajectory of improvement was apparent in the 2023 results. The aquatic life use attainment status in 2023 was a mix of full and partial attainment which is a similar result to the most immediate prior survey years of 2016 and 2021. The longitudinal patterns in the fish IBI, MIwb, and macroinvertebrate ICI were not appreciably different in 2023 than in 2011, 2016, and 2021. In some instances, the index values were among the highest recorded with some values exceeding the WWH biocriteria. The lower sites that were most affected by the sewage releases showed similar results to the prior years. The trajectory of improvement in Mill Creek that was first observed in 2011 and 2016 was essentially maintained with no appreciable decline in AAV values that would suggest a lingering impact. Given that upstream impacts are still present and largely unchanged, it would be difficult to assign the short-term releases of sewage any role in the 2023 biological results. An examination of sediment chemistry results (Appendix A) showed exceedances of polycyclic aromatic hydrocarbons (PAH), metals, and VOCs that are in line with similar results observed in prior survey years and a product of general urban runoff in the overall Mill Creek watershed as has been documented previously.

Appendix A: Water and Sediment Chemistry Results

***Appendix Table A-1**. Water chemistry results collected with a YSI 556 meter during the fish sampling pass in August 2023.*

Site ID	River_Stream Name	Location Description	River Mile	Drainage Area (mi.^{2})	Gradient (ft./mi.)	Tempera-ture (°C)	Conduc-tivity (µS/cm)	D.O. (mg/L)	pH (S.U.)
MC75	Mill Creek	Salway Park	5.1	139	7.0	25.2	982	4.28	7.58
MC74	Mill Creek	Ust S Ludlow Ave	4.3	141	6.83	25.6	963	8.07	7.85
MC73	Mill Creek	Ust Mill Creek Rd	3.5	144	6.72	28.4	966	10.13	8.03
MC72	Mill Creek	Dst Mill Creek Rd	3.1	154	6.89	27.1	976	8.53	7.96
MC05	Mill Creek	Dst. Hopple Street bridge	2.5	156	1.86	26	901	7.32	7.95
MC03	Mill Creek	Dst Lick Run	1.07	163	6.35	20.8	819	8.92	7.84
MC71	Mill Creek	Ust Mill Creek WWTP	0.7	165	6.52	21.6	802	7.14	7.76
MC70	Mill Creek	Dst. Mill Creek WWTP	0.3	165	6.43	23.8	775	8.01	7.91
MC69	Mill Creek	R.R. trestle - Queensgate	0.05	166	1.86	24.5	509	8.01	7.59

***Appendix Table A-2**. Sediment metals results in Lower Mill Creek in 2023. Results are evaluated against MacDonald et al. (2000) effect thresholds and Ohio EPA Sediment Reference Values (Footnotes: SRV – sediment reference values; TEC – threshold effect concentration; PEC – probable effect concentration).*

Site ID	River Mile	Drainage Area (mi.^{2})	Arsenic (mg/kg)	Calcium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Zinc (mg/kg)
Scioto River								
MC75	5.10	136	ND	10000	6	2500	4	25
MC74	4.25	141	ND	20000	10	3700	10	36
MC73	3.50	154	ND	7800	5	2000	4	18
MC72	3.10	155	ND	7900	5	2500	4	21
MC05	2.50	154	1.2	8100	4	1300	3	12
MC03	1.70	163	ND	24000	13	5600	15	51
MC71	0.70	165	ND	28000	27	8400	36	95
MC70	0.30	165	ND	39000	14	6100	320	68
MC69	0.05	166	ND	16000	16	6000	15	88
Ohio EPA		SRV	25.1	--	33	51000	47	170
MacDonald et al. (2000)		PEC	33.0	--	--	--	128	459
		TEC	9.8	--	32	--	23	121

MacDonald, R.S. Carr, F.D. Calder, E.R. Long, and C.G. Ingersoll. 2000. Development and evaluation of sediment guidelines for Florida coastal waters. Ecotoxicology 5: 253-278.

Ohio EPA. 2008. Guidance for Conducting Ecological Risk Assessments. DERR-00-RR-031. Div. Env. Remedial Response, Columbus, OH. 130 pp.

***Appendix Table A-3**. Sediment PAH compound results in Lower Mill Creek in 2023. Results are evaluated against MacDonald et al. (2000) and Persuad et al. (1993) effect thresholds (Footnotes: AE – not reported due to lab error; SRV – sediment reference values; TEC – threshold effect concentration; PEC – probable effect concentration).*

Site ID	River Mile	Drainage Area (Sq. mi.)	Acenaphthene (mg/kg dry)	Acenaphthylene (mg/kg dry)	Anthracene (mg/kg dry)	Benzo(a)anthracene (mg/kg dry)	Benzo(a)pyrene (mg/kg dry)	Benzo(b)fluoranthene (mg/kg dry)	Benzo(g,h,i)perylene (mg/kg dry)	Benzo(k)fluoranthene (mg/kg dry)	Carbazole (mg/kg dry)	Chrysene (mg/kg dry)	Dibenzo(a,h)anthracene (mg/kg dry)	Fluoranthene (mg/kg dry)	Fluorene (mg/kg dry)	Indeno(1,2,3-cd)pyrene (mg/kg dry)	Naphthalene (mg/kg dry)	n-Octadecane (mg/kg dry)	Phenanthrene (mg/kg dry)	Phenol (mg/kg dry)	Pyrene (mg/kg dry)
Mill Creek 2023																					
MC75	5.10	136.0	AE	AE	AE	AE	AE	AE	AE	AE	AE	AE	AE	AE	AE	AE	AE	AE	AE	AE	AE
MC74	4.25	141.0	ND	ND	0.300	1.400	2.300	3.200	1.800	1.200	ND	2.000	0.570	4.600	ND	2.000	ND	ND	1.600	ND	3.200
MC73	3.50	154.0	ND	ND	0.120	0.710	1.200	1.900	1.100	0.620	ND	1.000	ND	2.100	ND	1.100	ND	ND	0.580	0.520	1.600
MC72	3.10	155.0	ND	ND	0.190	0.720	1.400	1.900	1.200	0.620	ND	1.100	0.370	2.100	ND	1.100	ND	ND	0.600	ND	1.600
MC05	2.50	154.0	ND	0.250	0.580	2.200	2.600	3.400	1.700	1.300	ND	2.300	0.440	5.600	0.160	1.900	ND	ND	2.800	ND	3.800
MC03	1.70	163.0	0.067	0.055	0.450	1.900	2.500	3.500	1.800	1.100	0.370	2.400	0.430	5.500	0.150	2.000	ND	0.229	2.200	ND	3.900
MC71	0.70	165.0	ND	0.099	0.270	1.400	1.900	2.700	1.400	0.960	0.340	1.800	0.300	4.100	0.088	1.500	0.061	0.200	1.600	ND	2.800
MC70	0.30	165.0	ND	ND	0.190	0.920	1.300	1.900	1.100	0.660	0.240	1.200	0.230	2.600	0.052	1.100	ND	0.238	0.850	ND	1.800
MC69	0.05	166.0	ND	ND	0.180	1.000	1.700	2.700	1.500	0.840	ND	1.700	0.310	3.200	ND	1.600	ND	ND	0.960	ND	2.500
MacDonald et al. (2000) Thresholds	PEC	--	--	>0.845	>1.050	--	--	--	--	--	>1.29	--	>2.230	>0.536	--	--	--	>1.170	--	>1.520
	TEC	--	--	>0.057	>0.108	--	--	--	--	--	>0.166	>0.033	>0.423	>0.077	--	--	--	>0.204	--	>0.195
Persaud et al. (1993) Thresholds	SEL	--	>0.088	>370	>1480	>1440	>1340	>320	>1340	--	>460	>130	>1020	>160	>320	--	--	>950	--	>850
	LEL	--	>0.0067	>0.220	>0.320	>0.370	>0.240	>0.170	>0.240	--	>0.340	>0.060	>0.750	>0.190	>0.200	--	--	>0.560	--	>0.490

MacDonald, R.S. Carr, F.D. Calder, E.R. Long, and C.G. Ingersoll. 2000. Development and evaluation of sediment guidelines for Florida coastal waters. Ecotoxicology 5: 253-278.

Persuad D., R. Jaagumagi, and A. Hayton. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Ontario Ministry of Environment and Energy, Toronto, ON. 27 pp.

***Appendix Table A-4**. Sediment volatile organic compound (VOC) results in Lower Mill Creek in 2023. Results are evaluated against MacDonald et al. (2000) and Persuad et al. (1993) effect thresholds (SRV – sediment reference values; TEC – threshold effect concentration; PEC – probable effect concentration; SEL – Severe Effect Level; LEL – Lowest Effect Level).*

Site ID	River Mile	Drainage Area (Sq. mi.)	Aroclor 1254 (mg/kg dry)	1,2,4-Trichlorobenzene (mg/kg dry)	Bis(2-ethylhexyl)phthalate (mg/kg dry)	1,4-Dichlorobenzene (mg/kg dry)	Chlorobenzene (mg/kg dry)	p-cresol (mg/kg dry)	Toluene (mg/kg dry)
Mill Creek 2023									
MC75	5.10	136.0	AE	AE	AE	0.470	1.300	0.080	ND
MC74	4.25	141.0	AE	0.650	1.400	AE	AE	ND	AE
MC73	3.50	154.0	ND	ND	1.000	ND	ND	2.500	ND
MC72	3.10	155.0	AE	ND	1.100	ND	ND	ND	ND
MC05	2.50	154.0	AE	ND	ND	AE	AE	1.700	AE
MC03	1.70	163.0	0.051	ND	0.480	AE	AE	ND	AE
MC71	0.70	165.0	AE	0.150	0.620	0.130	ND	0.160	ND
MC70	0.30	165.0	ND	ND	0.680	0.250	ND	0.230	0.620
MC69	0.05	166.0	0.110	ND	0.930	0.390	ND	0.350	0.130
MacDonald et al. (2000) Thresholds	PEC	--	--	--	--	--	--	--	--
	TEC	--	--	--	--	--	--	--	--
Persaud et al. (1993) Thresholds	SEL	340.000	--	--	--	--	--	--	--
	LEL	60.000	--	--	--	--	--	--	--

MacDonald, R.S. Carr, F.D. Calder, E.R. Long, and C.G. Ingersoll. 2000. Development and evaluation of sediment guidelines for Florida coastal waters. Ecotoxicology 5: 253-278.

Persuad D., R. Jaagumagi, and A. Hayton. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Ontario Ministry of Environment and Energy, Toronto, ON. 27 pp.

Appendix B: Fish Assemblage Metrics and Data

Appendix Table B-1. Boatable Ohio IBI scores and metrics for data collected in Lower Mill Creek in 2023.

Site ID	River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Number of: Sunfish species	Number of: Sucker species	Number of: Intolerant species	Percent of Individuals: Rnd-bodied suckers	Percent of Individuals: Simple Lithophils	Percent of Individuals: Tolerant fishes	Percent of Individuals: Omni-vores	Percent of Individuals: Top carnivores	Percent of Individuals: Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)		IBI	Modified Iwb	Source
Mill Creek - (23001)																				
Year: 2023																				
MC03	1.70	P	10/03/2023	163	16(3)	3(3)	5(3)	0(1)	3(1)	5(1)	5(5)	49(1)	8(3)	40(3)	1.1(3)	332(3)		30	8.2	MBI
MC71	0.70	P	10/03/2023	165	13(3)	3(3)	4(3)	0(1)	2(1)	5(1)	10(5)	43(1)	7(3)	46(3)	0.5(3)	328(3)		30	8.4	MBI
MC70	0.30	P	10/03/2023	166	10(3)	2(3)	2(1)	0(1)	0(1)	3(1)	6(5)	49(1)	9(3)	38(3)	0.0(5)	164(1)	*	28	8.2	MBI
MC69	0.10	P	10/03/2023	166	14(3)	3(3)	4(3)	0(1)	2(1)	3(1)	4(5)	54(1)	9(3)	37(3)	1.0(5)	240(3)		32	7.7	MBI

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

Appendix Table B-2. Wadeable IBI scores and metrics for site sampled in Lower Mill Creek in 2023.

Site ID	River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Darter species	Percent of Individuals: Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)		IBI	Modified Iwb
Mill Creek - (23001)																			
Year: 2023																			
MC75	5.10	D	08/22/2023	136.0	7(1)	3(3)	1(1)	0(1)	0(1)	0(1)	15(5)	30(3)	0.0(1)	69(5)	1.0(3)	134(1)	*	26	5.6
MC74	4.30	D	08/22/2023	141.0	18(3)	4(5)	4(3)	0(1)	3(3)	12(1)	0(5)	30(3)	1.7(3)	64(5)	0.0(5)	363(3)		40	7.5
MC73	3.50	D	08/22/2023	154.0	23(5)	3(3)	5(5)	0(1)	2(1)	8(1)	11(5)	18(5)	7.6(5)	72(5)	0.4(3)	350(3)		42	8.0
MC72	3.10	D	08/22/2023	155.0	25(5)	2(3)	6(5)	0(1)	4(3)	8(1)	3(5)	27(3)	4.1(3)	64(5)	0.4(5)	387(3)		42	8.1
MC05	2.50	D	08/23/2023	154.0	19(3)	1(1)	3(3)	1(1)	2(1)	10(1)	0(5)	11(5)	3.9(3)	75(5)	0.8(3)	584(3)		34	7.4

na - Qualitative data, Modified Iwb not applicable.

♦ - 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-3: Midwest Biodiversity Institute
Fish Species List - Grand Totals

Rivers: *Mill Creek*

Years: 2023

Number of Samples: 9 Data Sources: 99 Data Types: D; P

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		3	1.1	0.17	1123	2.57	1066.6
20-001	Skipjack Herring	P		M		11	3.9	0.61	87	0.20	22.7
20-003	Gizzard Shad	O		M		439	154.1	24.38	6075	13.89	39.4
40-004	Smallmouth Buffalo	I		M	C	38	13.3	2.11	9705	22.18	727.6
40-005	Quillback Carpsucker	O		M	C	10	3.5	0.56	682	1.56	194.5
40-006	River Carpsucker	O		M	C	22	7.7	1.22	6479	14.81	839.0
40-008	Silver Redhorse	I	M	S	R	4	1.4	0.22	70	0.16	50.0
40-010	Golden Redhorse	I	M	S	R	5	1.8	0.28	203	0.47	116.0
40-015	Northern Hog Sucker	I	M	S	R	63	22.1	3.50	442	1.01	20.0
40-016	White Sucker	O	T	S	W	5	0.5	0.28	4	0.03	8.0
40-018	Spotted Sucker	I		S	R	2	0.7	0.11	35	0.08	50.0
40-023	Smallmouth Redhorse	I	M	S	R	7	2.5	0.39	317	0.73	129.2
43-001	Common Carp	O	T	M	G	29	10.2	1.61	6230	14.24	612.0
43-006	Silver Chub	I		M	N	2	0.7	0.11	10	0.02	15.0
43-015	Suckermouth Minnow	I		S	N	15	1.6	0.83	7	0.06	4.6
43-020	Emerald Shiner	I		M	N	544	190.9	30.21	266	0.61	1.3
43-028	Spottail Shiner	I	P	M	N	1	0.4	0.06	2	0.00	6.0
43-032	Spotfin Shiner	I		M	N	6	0.6	0.33	1	0.01	2.6
43-034	Sand Shiner	I	M	M	N	47	4.9	2.61	10	0.08	2.0
43-043	Bluntnose Minnow	O	T	C	N	20	2.1	1.11	7	0.06	3.5
43-044	Central Stoneroller	H		N	N	14	1.5	0.78	8	0.06	5.7
43-063	Channel Shiner	I	I	M	N	6	0.6	0.33	0	0.00	0.6
47-002	Channel Catfish			C	F	35	12.3	1.94	3846	8.79	313.1
47-007	Flathead Catfish	P		C	F	1	0.1	0.06	4	0.03	40.0
74-001	White Bass	P		M	F	1	0.1	0.06	4	0.03	40.0
74-005	Striped Bass X White Bass				E	13	1.4	0.72	630	4.81	461.5
77-002	Black Crappie	I		C	S	1	0.1	0.06	16	0.13	160.0
77-004	Smallmouth Bass	C	M	C	F	7	0.7	0.39	13	0.10	17.8
77-005	Spotted Bass	C		C	F	48	16.9	2.67	694	1.59	41.2
77-006	Largemouth Bass	C		C	F	8	2.8	0.44	273	0.63	97.5
77-008	Green Sunfish	I	T	C	S	36	12.6	2.00	235	0.54	18.6
77-009	Bluegill Sunfish	I	P	C	S	57	20.0	3.16	556	1.27	27.8
77-010	Orangespotted Sunfish	I		C	S	2	0.2	0.11	3	0.02	15.0
77-011	Longear Sunfish	I	M	C	S	238	83.5	13.21	1354	3.10	16.2
77-015	Green X Bluegill Sunfish					4	1.4	0.22	31	0.07	22.5
80-001	Sauger	P		S	F	13	4.6	0.72	638	1.46	140.0
80-011	Logperch	I	M	S	D	5	1.8	0.28	23	0.05	13.6
80-014	Johnny Darter	I		C	D	2	0.2	0.11	0	0.00	1.0
80-015	Greenside Darter	I	M	S	D	5	0.5	0.28	4	0.03	8.6
80-022	Rainbow Darter	I	M	S	D	10	1.1	0.56	1	0.01	1.7

Appendix B-3: Midwest Biodiversity Institute
Fish Species List - Grand Totals

Rivers: *Mill Creek*

Years: 2023

Number of Samples: 9 Data Sources: 99 Data Types: D; P

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
80-024	Fantail Darter	I		C	D	1	0.1	0.06	0	0.00	2.0
85-001	Freshwater Drum		P	M		21	7.4	1.17	1965	4.49	266.6

No Species: 42 **Nat. Species:** 39 **Hybrids:** 2 **Total Counted:** 1801 **Total Rel. Wt. :** 42071

Appendix Table B-3. Midwest Biodiversity Institute
Fish Species List

Site ID: MC75 River: 23-001 Mill Creek RM: 5.10 Date: 08/22/2023

Time Fished: 1503 Distance: 0.200 Drainge (sq mi): 139.0 Depth: 0

Location: Adj. Salway Park Lat: 39.16120 Long: -84.52632

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		14	21.0	13.33	3825	14.88	182.1
40-005	Quillback Carpsucker	O		M	C	1	1.5	0.95	525	2.04	350.0
43-001	Common Carp	O	T	M	G	16	24.0	15.24	18300	71.18	762.5
43-020	Emerald Shiner	I		M	N	28	42.0	26.67	60	0.23	1.4
47-002	Channel Catfish			C	F	2	3.0	1.90	675	2.63	225.0
77-002	Black Crappie	I		C	S	1	1.5	0.95	240	0.93	160.0
77-009	Bluegill Sunfish	I	P	C	S	13	19.5	12.38	1230	4.78	63.0
77-011	Longear Sunfish	I	M	C	S	30	45.0	28.57	855	3.33	19.0

No Species: 8 **Nat. Species:** 7 **Hybrids:** 0 **Total Counted:** 105 **Total Rel. Wt. :** 25710

IBI: 26.0 **MIwb:** 5.6

Appendix Table B-3. Midwest Biodiversity Institute
Fish Species List

Site ID: MC74 River: 23-001 Mill Creek RM: 4.30 Date: 08/22/2023

Time Fished: 1892 Distance: 0.200 Drainge (sq mi): 141.0 Depth: 0

Location: Ust. S. Ludlow Ave. bridge Lat: 39.15802 Long: -84.53701

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		72	108.0	29.63	13875	67.08	128.4
40-005	Quillback Carpsucker	O		M	C	1	1.5	0.41	750	3.63	500.0
40-006	River Carpsucker	O		M	C	1	1.5	0.41	1515	7.32	1010.0
40-015	Northern Hog Sucker	I	M	S	R	21	31.5	8.64	1410	6.82	44.7
40-023	Smallmouth Redhorse	I	M	S	R	2	3.0	0.82	600	2.90	200.0
43-020	Emerald Shiner	I		M	N	99	148.5	40.74	157	0.76	1.0
43-034	Sand Shiner	I	M	M	N	2	3.0	0.82	4	0.02	1.5
47-002	Channel Catfish			C	F	2	3.0	0.82	765	3.70	255.0
77-004	Smallmouth Bass	C	M	C	F	3	4.5	1.23	75	0.36	16.6
77-006	Largemouth Bass	C		C	F	1	1.5	0.41	7	0.04	5.0
77-008	Green Sunfish	I	T	C	S	1	1.5	0.41	30	0.15	20.0
77-009	Bluegill Sunfish	I	P	C	S	4	6.0	1.65	375	1.81	62.5
77-010	Orangespotted Sunfish	I		C	S	1	1.5	0.41	15	0.07	10.0
77-011	Longear Sunfish	I	M	C	S	20	30.0	8.23	480	2.32	16.0
77-015	Green X Bluegill Sunfish					1	1.5	0.41	30	0.15	20.0
80-011	Logperch	I	M	S	D	3	4.5	1.23	67	0.33	15.0
80-014	Johnny Darter	I		C	D	1	1.5	0.41	1	0.01	1.0
80-015	Greenside Darter	I	M	S	D	2	3.0	0.82	30	0.15	10.0
85-001	Freshwater Drum		P	M		6	9.0	2.47	495	2.39	55.0

No Species: 18 **Nat. Species:** 18 **Hybrids:** 1 **Total Counted:** 243 **Total Rel. Wt. :** 20683

IBI: 40.0 **MIwb:** 7.5

Appendix Table B-3. Midwest Biodiversity Institute
Fish Species List

Site ID: MC73 River: 23-001 Mill Creek RM: 3.50 Date: 08/22/2023

Time Fished: 1897 Distance: 0.200 Drainge (sq mi): 144.0 Depth: 0

Location: Ust. Mill Creek Rd. bridge Lat: 39.14975 Long: -84.54543

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		22	33.0	8.40	465	1.29	14.0
40-004	Smallmouth Buffalo	I		M	C	2	3.0	0.76	6150	17.11	2050.0
40-005	Quillback Carpsucker	O		M	C	3	4.5	1.15	3750	10.43	833.3
40-010	Golden Redhorse	I	M	S	R	1	1.5	0.38	120	0.33	80.0
40-015	Northern Hog Sucker	I	M	S	R	15	22.5	5.73	1020	2.84	45.3
40-016	White Sucker	O	T	S	W	2	3.0	0.76	45	0.13	15.0
43-001	Common Carp	O	T	M	G	5	7.5	1.91	20100	55.92	2680.0
43-020	Emerald Shiner	I		M	N	96	144.0	36.64	180	0.50	1.2
43-032	Spotfin Shiner	I		M	N	3	4.5	1.15	15	0.04	3.3
43-034	Sand Shiner	I	M	M	N	22	33.0	8.40	60	0.17	1.8
43-043	Bluntnose Minnow	O	T	C	N	15	22.5	5.73	75	0.21	3.3
43-044	Central Stoneroller	H		N	N	3	4.5	1.15	30	0.08	6.6
47-002	Channel Catfish			C	F	1	1.5	0.38	1650	4.59	1100.0
47-007	Flathead Catfish	P		C	F	1	1.5	0.38	60	0.17	40.0
77-004	Smallmouth Bass	C	M	C	F	2	3.0	0.76	45	0.13	15.0
77-005	Spotted Bass	C		C	F	15	22.5	5.73	150	0.42	6.6
77-006	Largemouth Bass	C		C	F	1	1.5	0.38	300	0.83	200.0
77-008	Green Sunfish	I	T	C	S	7	10.5	2.67	240	0.67	22.8
77-009	Bluegill Sunfish	I	P	C	S	1	1.5	0.38	60	0.17	40.0
77-011	Longear Sunfish	I	M	C	S	38	57.0	14.50	975	2.71	17.1
77-015	Green X Bluegill Sunfish					1	1.5	0.38	45	0.13	30.0
80-001	Sauger	P		S	F	1	1.5	0.38	315	0.88	210.0
80-015	Greenside Darter	I	M	S	D	2	3.0	0.76	30	0.08	10.0
80-022	Rainbow Darter	I	M	S	D	1	1.5	0.38	3	0.01	2.0
85-001	Freshwater Drum		P	M		2	3.0	0.76	60	0.17	20.0

No Species: 24 **Nat. Species:** 23 **Hybrids:** 1 **Total Counted:** 262 **Total Rel. Wt. :** 35943

IBI: 42.0 **MIwb:** 8.0

Appendix Table B-3. Midwest Biodiversity Institute
Fish Species List

Site ID: MC72 River: 23-001 Mill Creek RM: 3.10 Date: 08/22/2023

Time Fished: 0 Distance: 0.200 Drainge (sq mi): 154.0 Depth: 0

Location: dst. Mill Creek Rd. Lat: 39.14501 Long: -84.54777

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-001	Skipjack Herring	P		M		1	1.5	0.37	30	0.39	20.0
20-003	Gizzard Shad	O		M		64	96.0	23.97	1335	17.27	13.9
40-004	Smallmouth Buffalo	I		M	C	1	1.5	0.37	3075	39.78	2050.0
40-008	Silver Redhorse	I	M	S	R	2	3.0	0.75	225	2.91	75.0
40-010	Golden Redhorse	I	M	S	R	2	3.0	0.75	225	2.91	75.0
40-015	Northern Hog Sucker	I	M	S	R	3	4.5	1.12	75	0.97	16.6
40-016	White Sucker	O	T	S	W	3	4.5	1.12	15	0.19	3.3
40-023	Smallmouth Redhorse	I	M	S	R	1	1.5	0.37	7	0.10	5.0
43-015	Suckermouth Minnow	I		S	N	2	3.0	0.75	15	0.19	5.0
43-020	Emerald Shiner	I		M	N	86	129.0	32.21	180	2.33	1.3
43-032	Spotfin Shiner	I		M	N	3	4.5	1.12	9	0.12	2.0
43-034	Sand Shiner	I	M	M	N	20	30.0	7.49	75	0.97	2.5
43-043	Bluntnose Minnow	O	T	C	N	5	7.5	1.87	30	0.39	4.0
43-044	Central Stoneroller	H		N	N	6	9.0	2.25	45	0.58	5.0
77-004	Smallmouth Bass	C	M	C	F	1	1.5	0.37	7	0.10	5.0
77-005	Spotted Bass	C		C	F	6	9.0	2.25	420	5.43	46.6
77-006	Largemouth Bass	C		C	F	1	1.5	0.37	465	6.02	310.0
77-008	Green Sunfish	I	T	C	S	1	1.5	0.37	15	0.19	10.0
77-011	Longear Sunfish	I	M	C	S	42	63.0	15.73	1245	16.11	19.7
80-001	Sauger	P		S	F	2	3.0	0.75	135	1.75	45.0
80-011	Logperch	I	M	S	D	1	1.5	0.37	12	0.16	8.0
80-014	Johnny Darter	I		C	D	1	1.5	0.37	1	0.02	1.0
80-015	Greenside Darter	I	M	S	D	1	1.5	0.37	4	0.06	3.0
80-022	Rainbow Darter	I	M	S	D	5	7.5	1.87	7	0.10	1.0
85-001	Freshwater Drum		P	M		7	10.5	2.62	75	0.97	7.1

No Species: 25 **Nat. Species:** 25 **Hybrids:** 0 **Total Counted:** 267 **Total Rel. Wt. :** 7729

IBI: 42.0 **MIwb:** 8.1

Appendix Table B-3. Midwest Biodiversity Institute
Fish Species List

Site ID: MC05 River: 23-001 Mill Creek RM: 2.50 Date: 08/23/2023

Time Fished: 1930 Distance: 0.200 Drainge (sq mi): 156.0 Depth: 0

Location: dst. Hopple St. bridge Lat: 39.13513 Long: -84.54562

Species Code:	Species Name:	Feed Guild	Toler-ance	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	0.26	1650	2.53	1100.0
20-001	Skipjack Herring	P		M		9	13.5	2.31	300	0.46	22.2
20-003	Gizzard Shad	O		M		41	61.5	10.54	1590	2.43	25.8
40-004	Smallmouth Buffalo	I		M	C	7	10.5	1.80	24750	37.88	2357.1
40-005	Quillback Carpsucker	O		M	C	2	3.0	0.51	52	0.08	17.5
40-015	Northern Hog Sucker	I	M	S	R	23	34.5	5.91	1125	1.72	32.6
43-015	Suckermouth Minnow	I		S	N	13	19.5	3.34	90	0.14	4.6
43-020	Emerald Shiner	I		M	N	232	348.0	59.64	540	0.83	1.5
43-034	Sand Shiner	I	M	M	N	3	4.5	0.77	4	0.01	1.0
43-044	Central Stoneroller	H		N	N	5	7.5	1.29	45	0.07	6.0
43-063	Channel Shiner	I	I	M	N	6	9.0	1.54	6	0.01	0.6
47-002	Channel Catfish			C	F	22	33.0	5.66	6450	9.87	195.4
74-001	White Bass	P		M	F	1	1.5	0.26	60	0.09	40.0
74-005	Striped Bass X White Bass				E	13	19.5	3.34	28500	43.62	1461.5
77-004	Smallmouth Bass	C	M	C	F	1	1.5	0.26	60	0.09	40.0
77-005	Spotted Bass	C		C	F	3	4.5	0.77	45	0.07	10.0
77-010	Orangespotted Sunfish	I		C	S	1	1.5	0.26	30	0.05	20.0
80-022	Rainbow Darter	I	M	S	D	4	6.0	1.03	18	0.03	3.0
80-024	Fantail Darter	I		C	D	1	1.5	0.26	3	0.00	2.0
85-001	Freshwater Drum		P	M		1	1.5	0.26	15	0.02	10.0

No Species: 19 **Nat. Species:** 19 **Hybrids:** 1 **Total Counted:** 389 **Total Rel. Wt. :** 65334

IBI: 34.0 **MIwb:** 7.4

Appendix Table B-3. Midwest Biodiversity Institute
Fish Species List

Site ID: MC03 River: 23-001 Mill Creek RM: 1.70 Date: 10/03/2023

Time Fished: 2013 Distance: 0.500 Drainge (sq mi): 163.0 Depth: 0

Location: Dst. Lick Run CSO Lat: 39.12161 Long: -84.54259

Species Code:	Species Name:	Feed Guild	Toler-ance	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	0.57	3000	7.90	1500.0
20-003	Gizzard Shad	O		M		77	154.0	44.25	11120	29.29	72.2
40-004	Smallmouth Buffalo	I		M	C	1	2.0	0.57	3600	9.48	1800.0
40-005	Quillback Carpsucker	O		M	C	1	2.0	0.57	80	0.21	40.0
40-006	River Carpsucker	O		M	C	8	16.0	4.60	14100	37.14	881.2
40-015	Northern Hog Sucker	I	M	S	R	1	2.0	0.57	60	0.16	30.0
40-023	Smallmouth Redhorse	I	M	S	R	4	8.0	2.30	1120	2.95	140.0
43-006	Silver Chub	I		M	N	2	4.0	1.15	60	0.16	15.0
47-002	Channel Catfish			C	F	3	6.0	1.72	1400	3.69	233.3
77-005	Spotted Bass	C		C	F	7	14.0	4.02	1160	3.06	82.8
77-006	Largemouth Bass	C		C	F	4	8.0	2.30	500	1.32	62.5
77-008	Green Sunfish	I	T	C	S	8	16.0	4.60	280	0.74	17.5
77-009	Bluegill Sunfish	I	P	C	S	5	10.0	2.87	70	0.18	7.0
77-011	Longear Sunfish	I	M	C	S	48	96.0	27.59	1200	3.16	12.5
77-015	Green X Bluegill Sunfish					1	2.0	0.57	60	0.16	30.0
80-001	Sauger	P		S	F	2	4.0	1.15	120	0.32	30.0
80-011	Logperch	I	M	S	D	1	2.0	0.57	30	0.08	15.0

No Species: 16 **Nat. Species:** 16 **Hybrids:** 1 **Total Counted:** 174 **Total Rel. Wt. :** 37960

IBI: 30.0 **MIwb:** 8.2

Appendix Table B-3. Midwest Biodiversity Institute
Fish Species List

Site ID: MC71 River: 23-001 Mill Creek RM: 0.70 Date: 10/03/2023

Time Fished: 2090 Distance: 0.500 Drainge (sq mi): 165.0 Depth: 0

Location: Ust. Gest St. Bridge Lat: 39.11209 Long: -84.54486

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-003	Gizzard Shad	O		M		74	148.0	40.66	9800	24.43	66.2
40-004	Smallmouth Buffalo	I		M	C	1	2.0	0.55	1500	3.74	750.0
40-006	River Carpsucker	O		M	C	5	10.0	2.75	11800	29.42	1180.0
40-008	Silver Redhorse	I	M	S	R	2	4.0	1.10	100	0.25	25.0
40-018	Spotted Sucker	I		S	R	2	4.0	1.10	200	0.50	50.0
43-020	Emerald Shiner	I		M	N	2	4.0	1.10	20	0.05	5.0
47-002	Channel Catfish			C	F	4	8.0	2.20	4600	11.47	575.0
77-005	Spotted Bass	C		C	F	7	14.0	3.85	240	0.60	17.1
77-008	Green Sunfish	I	T	C	S	18	36.0	9.89	600	1.50	16.6
77-009	Bluegill Sunfish	I	P	C	S	18	36.0	9.89	620	1.55	17.2
77-011	Longear Sunfish	I	M	C	S	40	80.0	21.98	1450	3.62	18.1
80-001	Sauger	P		S	F	5	10.0	2.75	3140	7.83	314.0
85-001	Freshwater Drum		P	M		4	8.0	2.20	6040	15.06	755.0

No Species: 13 **Nat. Species:** 13 **Hybrids:** 0 **Total Counted:** 182 **Total Rel. Wt. :** 40110

IBI: 30.0 **Mlwb:** 8.4

Appendix Table B-3. Midwest Biodiversity Institute
Fish Species List

Site ID: MC70 River: 23-001 Mill Creek RM: 0.30 Date: 10/03/2023

Time Fished: 2110 Distance: 0.450 Drainge (sq mi): 165.0 Depth: 0

Location: Ust. Mill Creek WWTP Lat: 39.10530 Long: -84.54979

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
10-004	Longnose Gar	P		M		1	2.2	1.27	1333	0.78	600.0
20-003	Gizzard Shad	O		M		27	60.0	34.18	5399	3.15	90.0
40-004	Smallmouth Buffalo	I		M	C	18	40.0	22.78	95323	55.63	2383.3
40-006	River Carpsucker	O		M	C	7	15.6	8.86	18887	11.02	1214.2
43-001	Common Carp	O	T	M	G	5	11.1	6.33	38773	22.63	3490.0
47-002	Channel Catfish			C	F	1	2.2	1.27	5110	2.98	2300.0
77-005	Spotted Bass	C		C	F	4	8.9	5.06	1355	0.79	152.5
77-009	Bluegill Sunfish	I	P	C	S	4	8.9	5.06	44	0.03	5.0
77-011	Longear Sunfish	I	M	C	S	8	17.8	10.13	222	0.13	12.5
77-015	Green X Bluegill Sunfish					1	2.2	1.27	22	0.01	10.0
80-001	Sauger	P		S	F	2	4.4	2.53	88	0.05	20.0
85-001	Freshwater Drum		P	M		1	2.2	1.27	4777	2.79	2150.0

No Species: 11 **Nat. Species:** 10 **Hybrids:** 1 **Total Counted:** 79 **Total Rel. Wt. :** 171338

IBI: 28.0 **MIwb:** 8.2

Appendix Table B-3. Midwest Biodiversity Institute
Fish Species List

Site ID: MC69 River: 23-001 Mill Creek RM: 0.10 Date: 10/03/2023

Time Fished: 2048 Distance: 0.400 Drainge (sq mi): 164.0 Depth: 0

Location: RR trestle-Queensgate Lat: 39.10314 Long: -84.54501

Species Code:	Species Name:	Feed Guild	Toler-ance	Breed Guild	IBI Group	No. Fish	Rel. No.	% by No.	Rel. Wt.	% by Wt.	Av. Wt.
20-001	Skipjack Herring	P		M		1	2.5	1.00	75	0.11	30.0
20-003	Gizzard Shad	O		M		48	120.0	48.00	2825	3.97	23.5
40-004	Smallmouth Buffalo	I		M	C	8	20.0	8.00	38125	53.57	1906.2
40-005	Quillback Carpsucker	O		M	C	2	5.0	2.00	87	0.12	17.5
40-006	River Carpsucker	O		M	C	1	2.5	1.00	2625	3.69	1050.0
40-010	Golden Redhorse	I	M	S	R	2	5.0	2.00	900	1.26	180.0
43-001	Common Carp	O	T	M	G	3	7.5	3.00	23750	33.37	3166.6
43-020	Emerald Shiner	I		M	N	1	2.5	1.00	10	0.01	4.0
43-028	Spottail Shiner	I	P	M	N	1	2.5	1.00	15	0.02	6.0
77-005	Spotted Bass	C		C	F	6	15.0	6.00	1125	1.58	75.0
77-006	Largemouth Bass	C		C	F	1	2.5	1.00	37	0.05	15.0
77-008	Green Sunfish	I	T	C	S	1	2.5	1.00	100	0.14	40.0
77-009	Bluegill Sunfish	I	P	C	S	12	30.0	12.00	275	0.39	9.1
77-011	Longear Sunfish	I	M	C	S	12	30.0	12.00	425	0.60	14.1
80-001	Sauger	P		S	F	1	2.5	1.00	800	1.12	320.0

No Species: 15 **Nat. Species:** 14 **Hybrids:** 0 **Total Counted:** 100 **Total Rel. Wt. :** 71175

IBI: 32.0 **Mlwb:** 7.7

Appendix C: Macroinvertebrate Assemblage Metrics and Data

Appendix Table C-1. ICI metrics and values in the Lower Mill Creek study area during 2023.

Site ID	River Mile	Drainage Area (sq mi)	Number of				Percent:						ICI
			Total Taxa	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Mayflies	Caddis-flies	Tany-tarsini	Other Dipt/NI	Tolerant Organisms	Qual. EPT	
Mill Creek (23-001)													
Year: 2023													
MC75	5.10	136.0	39(6)	3(2)	3(4)	25(6)	3.5(2)	3.2(2)	7.7(2)	84.7(0)	17.1(0)	7(2)	26
MC74	4.30	141.0	25(4)	2(0)	3(4)	15(4)	3.4(2)	4.3(2)	11.6(2)	80.7(0)	15.2(0)	6(2)	20
MC73	3.50	154.0	34(4)	2(0)	4(4)	19(6)	2.9(2)	30.3(6)	12.3(2)	53.6(2)	11.7(2)	7(2)	30
MC72	3.10	155.0	26(4)	4(2)	4(4)	14(4)	2.6(2)	60.6(6)	9.1(2)	27.2(4)	1.7(6)	8(2)	36
MC05	2.50	154.0	31(4)	2(0)	5(6)	18(4)	3.3(2)	61.8(6)	3.6(2)	30.7(4)	4.6(6)	9(2)	36
MC03	1.70	163.0	31(4)	2(0)	3(4)	19(6)	3.0(2)	20.3(6)	5.1(2)	71.3(0)	15.8(0)	6(2)	26

Appendix Table C-2. Macroinvertebrate taxa list for sites sampled in the Mill Creek study area in 2023.

River Code: **23-001** River: ***Mill Creek*** Coll. Date: *08/31/2023* RM: **5.10**

Site ID: **MC75** Location: *Adj. Salway Park* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.	
01801	Turbellaria		F	47	+
03000	Ectoprocta		F	4	
03600	Oligochaeta		T	101	+
06201	Hyalella azteca		F	8	+
11120	Baetis flavistriga		F		+
11130	Baetis intercalaris		F		+
13521	Stenonema femoratum		F	2	+
16700	Tricorythodes sp		MI	2	+
17200	Caenis sp		F	36	+
21300	Hetaerina sp		F		+
22001	Coenagrionidae		T		+
22300	Argia sp		F	5	+
23501	Aeshnidae				+
51001	Polycentropodidae			2	
51206	Cyrnellus fraternus		F	8	
52200	Cheumatopsyche sp		F		+
53800	Hydroptila sp		F	26	+
60900	Peltodytes sp		MT		+
68601	Ancyronyx variegata		F	1	
69400	Stenelmis sp		F		+
72700	Anopheles sp		F		+
77120	Ablabesmyia mallochi		F	31	+
77130	Ablabesmyia rhamphe group		MT	24	
77500	Conchapelopia sp		F	31	+
77750	Hayesomyia senata or Thienemannimyia norena		F	47	
77800	Helopelopia sp		F	8	
78655	Procladius (Holotanypus) sp		MT		+
80410	Cricotopus (C.) sp		F	31	
80420	Cricotopus (C.) bicinctus		T	31	+
80510	Cricotopus (Isocladius) sylvestris group		T		+
81240	Nanocladius (N.) distinctus		MT	39	
82730	Chironomus (C.) decorus group		T	16	+
82820	Cryptochironomus sp		F	8	
83040	Dicrotendipes neomodestus		F	290	+
83050	Dicrotendipes lucifer		MT	86	
83300	Glyptotendipes (G.) sp		MT	8	
84155	Paralauterborniella nigrohalteralis		F	8	
84210	Paratendipes albimanus or P. duplicatus		F	8	
84300	Phaenopsectra obediens group		F	39	
84450	Polypedilum (Uresipedilum) flavum		F		+
84470	Polypedilum (P.) illinoense		T		+
84540	Polypedilum (Tripodura) scalaenum group		F	47	+
84700	Stenochironomus sp		F	8	
84790	Tribelos fuscicorne		F	8	
84960	Pseudochironomus sp		F	24	+
85230	Cladotanytarsus mancus group		F	8	
85265	Cladotanytarsus vanderwulpi group sp 5		MI	16	
85500	Paratanytarsus sp		F	16	
85625	Rheotanytarsus sp		F	16	+
85840	Tanytarsus sepp		F	31	
95501	Planorbidae		MT	1	
96900	Ferrissia sp		F	6	
97601	Corbicula fluminea		F		+

No. Quantitative Taxa:	39	Total Taxa;	53
No. Qualitative Taxa:	30	ICI:	26
Number of Organisms:	1128	Qual EPT:	7

Appendix Table C-2. Macroinvertebrate taxa list for sites sampled in the Mill Creek study area in 2023.

River Code: **23-001** River: ***Mill Creek*** Coll. Date: *08/30/2023* RM: **4.30**

Site ID: **MC74** Location: *Ust. S. Ludlow Ave. bridge* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria		F	64 +
03600	Oligochaeta		T	102 +
04615	Actinobdella inequiannulata		MT	+
06201	Hyalella azteca		F	3 +
08200	Orconectes sp		F	+
13000	Leucrocuta sp		MI	+
13521	Stenonema femoratum		F	14 +
16700	Tricorythodes sp		MI	+
17200	Caenis sp		F	23 +
22001	Coenagrionidae		T	+
22300	Argia sp		F	+
27001	Corduliidae			+
51206	Cyrnellus fraternus		F	2
52200	Cheumatopsyche sp		F	23 +
53800	Hydroptila sp		F	21 +
60900	Peltodytes sp		MT	+
65800	Berosus sp		MT	+
69400	Stenelmis sp		F	1 +
74501	Ceratopogonidae		T	2
77001	Tanypodinae			21
77120	Ablabesmyia mallochi		F	52 +
77130	Ablabesmyia rhamphe group		MT	21 +
77750	Hayesomyia senata or Thienemannimyia norena		F	126 +
78100	Labrundinia sp		F	10
78655	Procladius (Holotanypus) sp		MT	+
80420	Cricotopus (C.) bicinctus		T	52 +
81240	Nanocladius (N.) distinctus		MT	10 +
82730	Chironomus (C.) decorus group		T	+
82820	Cryptochironomus sp		F	+
82822	Cryptochironomus eminentia		F	+
83040	Dicrotendipes neomodestus		F	293 +
84155	Paralauterborniella nigrohalteralis		F	+
84300	Phaenopsectra obediens group		F	10 +
84520	Polypedilum (Tripodura) halterale group		MT	+
84540	Polypedilum (Tripodura) scalaenum group		F	73
84960	Pseudochironomus sp		F	31
85625	Rheotanytarsus sp		F	73
85821	Tanytarsus glabrescens group sp 7		F	21
85840	Tanytarsus sepp		F	31
93900	Elimia sp		MI	+
95100	Physella sp		T	+
97601	Corbicula fluminea		F	2

No. Quantitative Taxa:	25	Total Taxa;	42
No. Qualitative Taxa:	32	ICI:	20
Number of Organisms:	1081	Qual EPT:	6

Appendix Table C-2. Macroinvertebrate taxa list for sites sampled in the Mill Creek study area in 2023.

River Code: **23-001** River: ***Mill Creek*** Coll. Date: *08/30/2023* RM: **3.50**

Site ID: **MC73** Location: *Ust. Mill Creek Rd. bridge* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria		F	127 +
03000	Ectoprocta		F	4
03600	Oligochaeta		T	25 +
04660	Helobdella sp		MT	+
04901	Erpobdellidae		MT	1
05900	Lirceus sp		MT	1
11130	Baetis intercalaris		F	+
13000	Leucrocuta sp		MI	+
16700	Tricorythodes sp		MI	2 +
17200	Caenis sp		F	48 +
21001	Calopterygidae		F	8
21300	Hetaerina sp		F	+
22001	Coenagrionidae		T	+
22300	Argia sp		F	2 +
51206	Cyrnellus fraternus		F	8
52200	Cheumatopsyche sp		F	475 +
52430	Ceratopsyche morosa group		MI	20 +
53800	Hydroptila sp		F	13 +
59970	Petrophila sp		MI	+
65800	Berosus sp		MT	1
68601	Ancyronyx variegata		F	+
69400	Stenelmis sp		F	+
71500	Ormosia sp		MT	+
72900	Culex sp		T	8
77130	Ablabesmyia rhamphe group		MT	12 +
77500	Conchapelopia sp		F	139 +
77750	Hayesomyia senata or Thienemannimyia norena		F	220 +
77800	Helopelopia sp		F	23
80420	Cricotopus (C.) bicinctus		T	104 +
81240	Nanocladius (N.) distinctus		MT	58
82822	Cryptochironomus eminentia		F	+
83040	Dicrotendipes neomodestus		F	81 +
83050	Dicrotendipes lucifer		MT	12 +
83051	Dicrotendipes simpsoni		T	12
83300	Glyptotendipes (G.) sp		MT	+
83310	Glyptotendipes (Heynotendipes) chelonia		MI	23
84210	Paratendipes albimanus or P. duplicatus		F	12
84450	Polypedilum (Uresipedilum) flavum		F	23 +
84470	Polypedilum (P.) illinoense		T	+
84540	Polypedilum (Tripodura) scalaenum group		F	+
84700	Stenochironomus sp		F	12
84960	Pseudochironomus sp		F	12 +
85265	Cladotanytarsus vanderwulpi group sp 5		MI	12
85500	Paratanytarsus sp		F	23
85625	Rheotanytarsus sp		F	139
85821	Tanytarsus glabrescens group sp 7		F	35
97601	Corbicula fluminea		F	8 +

No. Quantitative Taxa:	34	Total Taxa;	47
No. Qualitative Taxa:	30	ICI:	30
Number of Organisms:	1703	Qual EPT:	7

Appendix Table C-2. Macroinvertebrate taxa list for sites sampled in the Mill Creek study area in 2023.

River Code: **23-001** River: ***Mill Creek*** Coll. Date: *08/30/2023* RM: **3.10**

Site ID: **MC72** Location: *dst. Mill Creek Rd.* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria		F	360 +
03000	Ectoprocta		F	5 +
03600	Oligochaeta		T	+
04935	Erpobdella punctata punctata		MT	+
06201	Hyalella azteca		F	+
06700	Crangonyx sp		MT	8
11119	Plauditus dubius or P. virilis		I	+
11130	Baetis intercalaris		F	85 +
11600	Paracloeodes fleeki		MI	+
12200	Isonychia sp		MI	1
16700	Tricorythodes sp		MI	32
17200	Caenis sp		F	1 +
21300	Hetaerina sp		F	+
22001	Coenagrionidae		T	+
22300	Argia sp		F	+
26600	Didymops transversa		MT	+
49101	Sisyridae		F	+
50315	Chimarra obscura		MI	5
51206	Cyrnellus fraternus		F	+
52200	Cheumatopsyche sp		F	2644 +
52430	Ceratopsyche morosa group		MI	134 +
53800	Hydroptila sp		F	42 +
67200	Hydrochara sp		MT	+
68601	Ancyronyx variegata		F	20
69400	Stenelmis sp		F	+
72900	Culex sp		T	+
77120	Ablabesmyia mallochi		F	+
77130	Ablabesmyia rhamphe group		MT	+
77500	Conchapelopia sp		F	376 +
77750	Hayesomyia senata or Thienemannimyia norena		F	114 +
77800	Helopelopia sp		F	16
78100	Labrundinia sp		F	16
80420	Cricotopus (C.) bicinctus		T	65 +
81240	Nanocladius (N.) distinctus		MT	16
82820	Cryptochironomus sp		F	+
83050	Dicrotendipes lucifer		MT	33 +
83310	Glyptotendipes (Heynotendipes) chelonia		MI	49 +
84300	Phaenopsectra obediens group		F	+
84450	Polypedilum (Uresipedilum) flavum		F	98 +
84470	Polypedilum (P.) illinoense		T	+
84540	Polypedilum (Tripodura) scalaenum group		F	+
84700	Stenochironomus sp		F	98
84960	Pseudochironomus sp		F	16 +
85230	Cladotanytarsus mancus group		F	+
85625	Rheotanytarsus sp		F	262
85800	Tanytarsus sp		F	16 +
85821	Tanytarsus glabrescens group sp 7		F	147
95100	Physella sp		T	+
97601	Corbicula fluminea		F	+

No. Quantitative Taxa:	26	Total Taxa;	49
No. Qualitative Taxa:	38	ICI:	36
Number of Organisms:	4659	Qual EPT:	8

Appendix Table C-2. Macroinvertebrate taxa list for sites sampled in the Mill Creek study area in 2023.

River Code: **23-001** River: ***Mill Creek*** Coll. Date: *08/29/2023* RM: **2.50**

Site ID: **MC05** Location: *dst. Hopple St. bridge* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria		F	168 +
03000	Ectoprocta		F	12
03600	Oligochaeta		T	+
06201	Hyalella azteca		F	1 +
08200	Orconectes sp		F	+
11120	Baetis flavistriga		F	2 +
11130	Baetis intercalaris		F	138 +
13521	Stenonema femoratum		F	+
17200	Caenis sp		F	+
21300	Hetaerina sp		F	+
22300	Argia sp		F	+
50315	Chimarra obscura		MI	2 +
52200	Cheumatopsyche sp		F	1872 +
52430	Ceratopsyche morosa group		MI	719 +
52450	Ceratopsyche sparna		F	4
52530	Hydropsyche depravata group		F	+
53800	Hydroptila sp		F	20 +
59970	Petrophila sp		MI	4 +
68601	Ancyronyx variegata		F	8
69400	Stenelmis sp		F	+
71900	Tipula sp		F	+
72700	Anopheles sp		F	+
77120	Ablabesmyia mallochi		F	+
77130	Ablabesmyia rhamphe group		MT	+
77500	Conchapelopia sp		F	367 +
77750	Hayesomyia senata or Thienemannimyia norena		F	13 +
77800	Helopelopia sp		F	+
78655	Procladius (Holotanypus) sp		MT	+
80310	Cardiocladius obscurus		MI	63
80410	Cricotopus (C.) sp		F	63 +
80420	Cricotopus (C.) bicinctus		T	139 +
81240	Nanocladius (N.) distinctus		MT	38 +
82200	Tvetenia bavarica group		MI	13
82730	Chironomus (C.) decorus group		T	+
83040	Dicrotendipes neomodestus		F	38 +
83050	Dicrotendipes lucifer		MT	13
83300	Glyptotendipes (G.) sp		MT	13
83310	Glyptotendipes (Heynotendipes) chelonia		MI	114
84040	Parachironomus frequens		F	51
84450	Polypedilum (Uresipedilum) flavum		F	152
84470	Polypedilum (P.) illinoense		T	+
84888	Xenochironomus xenolabis		F	+
84960	Pseudochironomus sp		F	38 +
85500	Paratanytarsus sp		F	13
85625	Rheotanytarsus sp		F	88
85800	Tanytarsus sp		F	25
85821	Tanytarsus glabrescens group sp 7		F	25
94400	Fossaria sp		MT	+
96900	Ferrissia sp		F	16
97601	Corbicula fluminea		F	+
98600	Sphaerium sp		F	+

No. Quantitative Taxa:	31	Total Taxa;	51
No. Qualitative Taxa:	36	ICI:	36
Number of Organisms:	4232	Qual EPT:	9

Appendix Table C-2. Macroinvertebrate taxa list for sites sampled in the Mill Creek study area in 2023.

River Code: **23-001** River: ***Mill Creek*** Coll. Date: *08/29/2023* RM: **1.70**

Site ID: **MC03** Location: *Dst. Lick Run CSO* Sample:

Taxa Code	Taxa	CWH Taxa	Tol.	Qt./Ql.
01801	Turbellaria		F	81 +
03000	Ectoprocta		F	1
03451	Urnatella gracilis		MI	2
03600	Oligochaeta		T	87 +
04901	Erpobdellidae		MT	1 +
05900	Lirceus sp		MT	1
06201	Hyalella azteca		F	+
08601	Hydrachnidia		F	+
11130	Baetis intercalaris		F	+
11200	Callibaetis sp		MT	+
13521	Stenonema femoratum		F	1
17200	Caenis sp		F	21 +
22300	Argia sp		F	+
27307	Epitheca (Epicordulia) princeps		MT	+
52200	Cheumatopsyche sp		F	124 +
52430	Ceratopsyche morosa group		MI	1 +
53800	Hydroptila sp		F	23 +
60900	Peltodytes sp		MT	+
63300	Hydroporini		T	+
65800	Berosus sp		MT	1
66700	Helochares maculicollis		T	+
69400	Stenelmis sp		F	+
71900	Tipula sp		F	1
77120	Ablabesmyia mallochi		F	5 +
77130	Ablabesmyia rhamphe group		MT	+
77500	Conchapelopia sp		F	23
77750	Hayesomyia senata or Thienemannimyia norena		F	56 +
78599	Pentaneura sp		F	5
80413	Cricotopus (Isocladius) sp "Ozarks"		MT	+
80420	Cricotopus (C.) bicinctus		T	14
82730	Chironomus (C.) decorus group		T	14
82822	Cryptochironomus eminentia		F	5
83040	Dicrotendipes neomodestus		F	107 +
83050	Dicrotendipes lucifer		MT	5
84040	Parachironomus frequens		F	5
84300	Phaenopsectra obediens group		F	9
84450	Polypedilum (Uresipedilum) flavum		F	14 +
84470	Polypedilum (P.) illinoense		T	+
84540	Polypedilum (Tripodura) scalaenum group		F	61 +
84960	Pseudochironomus sp		F	23 +
85265	Cladotanytarsus vanderwulpi group		MI	14
	sp 5			
85625	Rheotanytarsus sp		F	14
85821	Tanytarsus glabrescens group sp 7		F	9
87601	Dolichopodidae		MT	1
95100	Physella sp		T	+

No. Quantitative Taxa:	31	Total Taxa;	45
No. Qualitative Taxa:	27	ICI:	26
Number of Organisms:	729	Qual EPT:	6

Appendix D: QHEI Metrics and Field Sheets

***Appendix Table D-1**. QHEI scores and metrics in the lower Mill Creek mainstem in 2023.*

Site ID	River Mile	QHEI	Substrate Score	Cover Score	Channel Score	Riparian Score	Pool Score	Riffle Score	Gradient Value	Gradient Score
MC75	5.1	**58.00**	13.0	13.0	9.0	5.0	8.0	0.0	7.00	10
MC74	4.3	**71.75**	14.0	15.0	12.0	6.8	9.0	5.0	6.83	10
MC73	3.5	**55.00**	12.0	13.0	10.0	4.5	4.0	1.5	6.72	10
MC72	3.1	**53.75**	11.5	11.0	9.5	5.8	4.0	2.0	6.89	10
MC05	2.5	**48.00**	11.0	6.0	9.5	4.5	6.0	5.0	1.86	6
MC03	1.7	**60.00**	13.0	16.0	9.0	5.0	7.0	0.0	6.35	10
MC71	0.7	**53.50**	13.0	13.0	5.0	5.5	7.0	0.0	6.52	10
MC70	0.3	**55.00**	13.5	15.0	5.0	4.5	7.0	0.0	6.43	10
MC69	0.1	**54.00**	14.0	12.0	10.0	4.0	8.0	0.0	1.86	6

QHEI Narrative	
Excellent	≥70
Good	≥55
Fair	≥43
Poor	≥30
Very Poor	<30

Ohio EPA — Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 54

Stream & Location: Mill Creek — Dst Flow-Through Dam RM: 0.1 Date: 10/3/2023

Scorers Full Name & Affiliation: Rankin

River Code: 23-001-___ STORET #: _____ Lat./Long.: 39.10314 184.54501 (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
☐ BLDR /SLABS [10]			☐ HARDPAN [4]		
☐ BOULDER [9]	✓		☐ DETRITUS [3]		
☒ COBBLE [8]	✓		☐ MUCK [2]		
☐ ☒ GRAVEL [7]	✓		☐ SILT [2]	✓	
☐ SAND [6]	✓		☐ ARTIFICIAL [0]		
☐ BEDROCK [5]			(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☑ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN
- ☐ LIMESTONE [1]
- ☑ TILLS [1]
- ☐ WETLANDS [0]
- ☐ HARDPAN [0]
- ☐ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTURINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY

SILT
- ☐ HEAVY [-2]
- ☒ MODERATE [-1]
- ☒ NORMAL [0]
- ☐ FREE [1]

EMBEDDEDNESS
- ☑ EXTENSIVE [-2]
- ☑ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

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.

2 UNDERCUT BANKS [1]	2 POOLS > 70cm [2]	0 OXBOWS, BACKWATERS [1]	
0 OVERHANGING VEGETATION [1]	1 ROOTWADS [1]	1 AQUATIC MACROPHYTES [1]	
1 SHALLOWS (IN SLOW WATER) [1]	2 BOULDERS [1]	1 LOGS OR WOODY DEBRIS [1]	
1 ROOTMATS [1]			

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: 12

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: 10

4] BANK EROSION AND RIPARIAN ZONE
Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION

L	R	
☒	☒	NONE / LITTLE [3]
☐	☐	MODERATE [2]
☐	☐	HEAVY / SEVERE [1]

RIPARIAN WIDTH

L	R	
☐	☐	WIDE > 50m [4]
☐	☐	MODERATE 10-50m [3]
☐	☐	NARROW 5-10m [2]
☒	☒	VERY NARROW < 5m [1]
☐	☐	NONE [0]

FLOOD PLAIN QUALITY

L	R	
☐	☐	FOREST, SWAMP [3]
☐	☐	SHRUB OR OLD FIELD [2]
☐	☐	RESIDENTIAL, PARK, NEW FIELD [1]
☐	☐	FENCED PASTURE [1]
☐	☐	OPEN PASTURE, ROWCROP [0]

L	R	
☐	☐	CONSERVATION TILLAGE [1]
☒	☒	URBAN OR INDUSTRIAL [0]
☐	☐	MINING / CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian Maximum 10: 4

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH (Check ONE (ONLY!))
- ☒ > 1m [6]
- ☐ 0.7-<1m [4]
- ☐ 0.4-<0.7m [2]
- ☐ 0.2-<0.4m [1]
- ☐ < 0.2m [0]

CHANNEL WIDTH (Check ONE (Or 2 & average))
- ☐ POOL WIDTH > RIFFLE WIDTH [2]
- ☒ POOL WIDTH = RIFFLE WIDTH [1]
- ☐ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY (Check ALL that apply)
- ☐ 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
(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: 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]

Comments

Riffle / Run Maximum 8: 0

6] GRADIENT
(1.86 ft/mi)

DRAINAGE AREA
(1164 mi²)

- ☐ VERY LOW - LOW [2-4]
- ☐ MODERATE [6-10]
- ☐ HIGH - VERY HIGH [10-6]

%POOL: ____ %GLIDE: ____
%RUN: ____ %RIFFLE: ____

Gradient Maximum 10: 6

Entered VA 10/27/23

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

_____ meters

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

1st pass _____ 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

C] RECREATION

POOL: AREA ☐ >100ft² DEPTH ☐ >3ft

D] MAINTENANCE

Circle some & COMMENT

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 H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

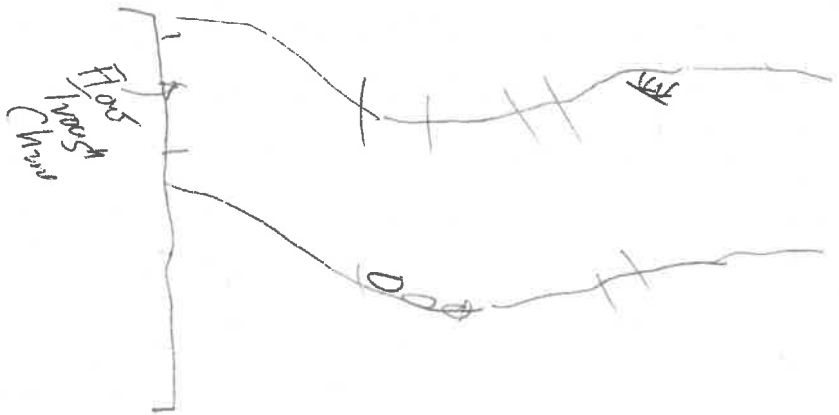
F] MEASUREMENTS

- $\bar{x}$ width
- $\bar{x}$ depth
- max. depth
- $\bar{x}$ bankfull width
- bankfull $\bar{x}$ depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Comment RE: Reach consistency/ Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

Stream Drawing:



MC05

Ohio EPA Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 48

Stream & Location: Mill Creek (MC05) dst. Hopple St. bridge **RM:** 2.5 **Date:** 8/23/23

Scorers Full Name & Affiliation: Rankin

River Code: 23-001- **STORET #:** **Lat./Long.:** 39.13513 184.54562 (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
☐ ☐ BLDR/SLABS [10]			☐ ☐ HARDPAN [4]		
☐ ☐ BOULDER [9]			☐ ☐ DETRITUS [3]		
☐ ☐ COBBLE [8]		✓	☐ ☐ MUCK [2]		
☐ ☒ GRAVEL [7]		✓	☐ ☐ SILT [2]	✓	✓
☒ ☐ SAND [6]	✓	✓	☐ ☐ ARTIFICIAL [0]	✓	
☐ ☐ BEDROCK [5]			(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☒ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN	SILT / EMBEDDEDNESS	QUALITY
☐ LIMESTONE [1]		☐ HEAVY [-2]
☒ TILLS [1]		☒ MODERATE [-1]
☐ WETLANDS [0]		☐ NORMAL [0]
☐ HARDPAN [0]		☐ FREE [1]
☐ SANDSTONE [0]		☒ EXTENSIVE [-2]
☒ RIP/RAP [0]		☒ MODERATE [-1]
☐ LACUSTURINE [0]		☐ NORMAL [0]
☐ SHALE [-1]		☐ NONE [1]
☐ COAL FINES [-2]		

Comments

Substrate 11 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.

1 UNDERCUT BANKS [1]	1 POOLS > 70cm [2]	1 OXBOWS, BACKWATERS [1]	AMOUNT (Check ONE (Or 2 & average))
0 OVERHANGING VEGETATION [1]	0 ROOTWADS [1]	0 AQUATIC MACROPHYTES [1]	☐ EXTENSIVE >75% [11]
1 SHALLOWS (IN SLOW WATER) [1]	2 BOULDERS [1]	0 LOGS OR WOODY DEBRIS [1]	☐ MODERATE 25-75% [7]
0 ROOTMATS [1]			☒ SPARSE 5-<25% [3]
			☐ NEARLY ABSENT <5% [1]

Comments

Cover Maximum 20: 6

3] CHANNEL MORPHOLOGY
Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☒ HIGH [3] Banks
☐ MODERATE [3]	☒ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]
☒ LOW [2]	☒ FAIR [3]	☒ RECOVERING [3]	☒ LOW [1] Bed Hom
☒ NONE [1]	☐ POOR [1]	☒ RECENT OR NO RECOVERY [1]	

Comments

Channel Maximum 20: 9.5

4] BANK EROSION AND RIPARIAN ZONE
Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R)	RIPARIAN WIDTH (L R)	FLOOD PLAIN QUALITY (L R)	(L R)
☒ ☒ NONE / LITTLE [3]	☐ ☐ WIDE > 50m [4]	☐ ☐ FOREST, SWAMP [3]	☐ ☐ CONSERVATION TILLAGE [1]
☐ ☐ MODERATE [2]	☐ ☐ MODERATE 10-50m [3]	☐ ☐ SHRUB OR OLD FIELD [2]	☒ ☒ URBAN OR INDUSTRIAL [0]
☐ ☐ HEAVY / SEVERE [1]	☒ ☐ NARROW 5-10m [2]	☐ ☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐ ☐ MINING / CONSTRUCTION [0]
	☒ ☐ VERY NARROW < 5m [1]	☐ ☐ FENCED PASTURE [1]	
	☐ ☐ NONE [0]	☐ ☐ 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 (Check ONE (ONLY!))
- ☐ > 1m [6]
- ☐ 0.7-<1m [4]
- ☒ 0.4-<0.7m [2]
- ☐ 0.2-<0.4m [1]
- ☐ < 0.2m [0]

CHANNEL WIDTH (Check ONE (Or 2 & average))
- ☐ POOL WIDTH > RIFFLE WIDTH [2]
- ☒ POOL WIDTH = RIFFLE WIDTH [1]
- ☐ POOL WIDTH > RIFFLE WIDTH [0]

CURRENT VELOCITY (Check ALL that apply)

☐ TORRENTIAL [-1]	☒ SLOW [1]
☐ VERY FAST [1]	☐ INTERSTITIAL [-1]
☒ FAST [1]	☐ INTERMITTENT [-2]
☒ MODERATE [1]	☐ EDDIES [1]

Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current Maximum 12: 6

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
☒ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☒ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☒ MAXIMUM < 50cm [1]	☒ MOD. STABLE (e.g., Large Gravel) [1]	☒ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☒ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run Maximum 8: 5

6] GRADIENT (1.86 ft/mi)

DRAINAGE AREA (156.0 mi²)

☐ VERY LOW - LOW [2-4] ☐ MODERATE [6-10] ☐ HIGH - VERY HIGH [10-8]

%POOL: %GLIDE: %RUN: %RIFFLE:

Gradient Maximum 10: 6

EPA 4520 06/16/06

entered 10/27/23 JA

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

meters

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

1st pass _____ cm

2nd _____ cm

C] RECREATION

POOL: AREA ☐ >100ft² DEPTH ☐ >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

Circle some & *COMMENT*

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 H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

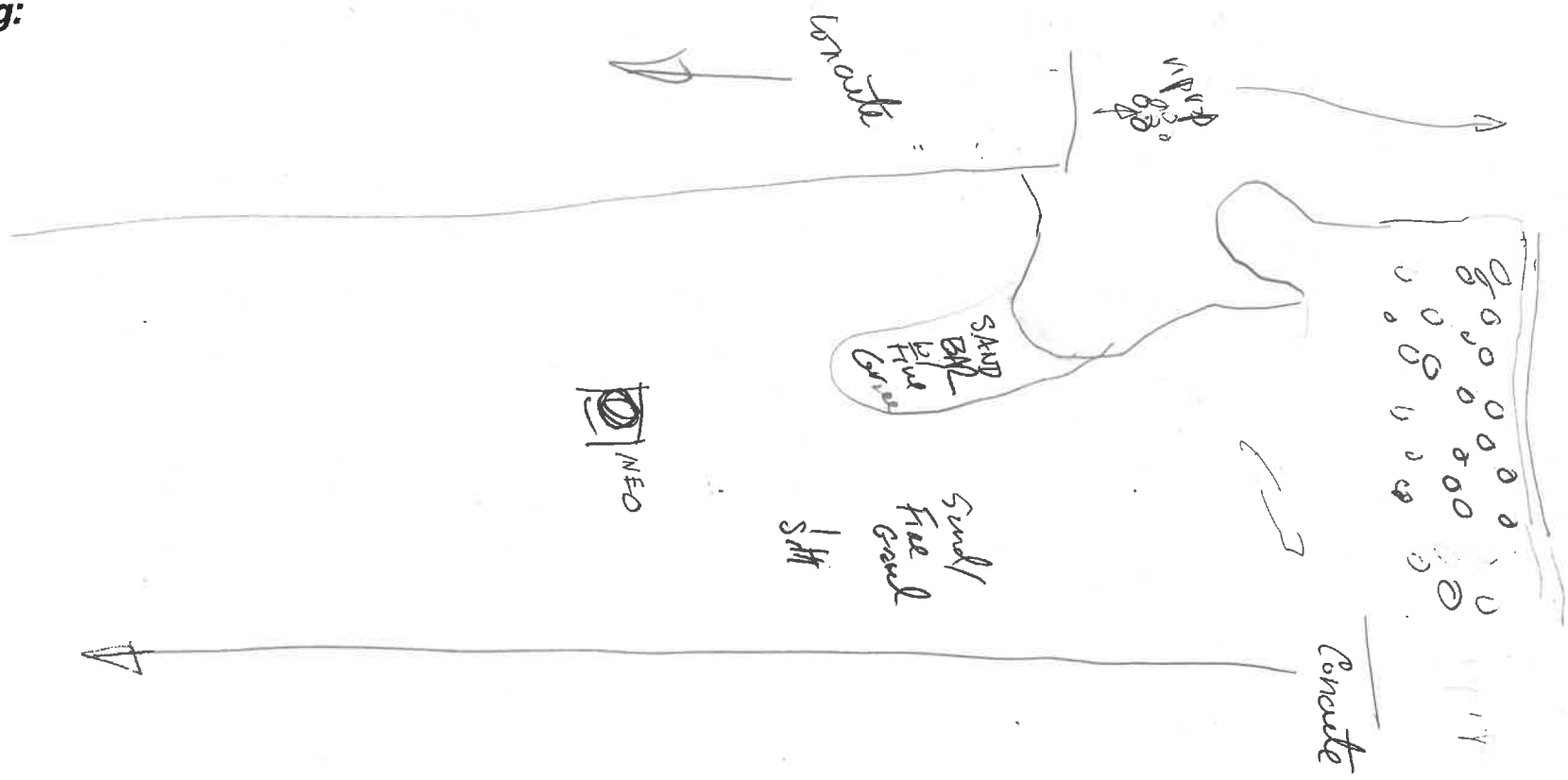
F] MEASUREMENTS

- $\bar{x}$ width
- $\bar{x}$ depth
- max. depth
- $\bar{x}$ bankfull width
- bankfull $\bar{x}$ depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Comment RE: Reach consistency/ Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

Stream Drawing:



Ohio EPA — Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 55

Stream & Location: Mill Creek Dst Mill Creek WWTP RM: 0.3 Date: 10/03/2023
MC 70
Scorers Full Name & Affiliation: MHS -> MBZ
River Code: 23-001- ___ STORET #: _____ Lat./Long.: 39.10715 184.54447 (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
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]	X	
☐☐ BOULDER [9]	X		☐☐ DETRITUS [3]	X	
☐☐ COBBLE [8]	X		☐☐ MUCK [2]		
☐☑ GRAVEL [7]	X		☐☐ SILT [2]	X	
☑☐ SAND [6]	X		☐☐ ARTIFICIAL [0]	X	
☐☐ BEDROCK [5]					

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☑ 4 or more [2] ☐ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN
- ☑ LIMESTONE [1]
- ☐ TILLS [1]
- ☐ WETLANDS [0]
- ☐ HARDPAN [0]
- ☐ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTURINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY

SILT
- ☐ HEAVY [-2]
- ☑ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ FREE [1]

EMBEDDEDNESS
- ☐ EXTENSIVE [-2]
- ☑ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

Comments

Substrate 13.5 / 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.

1 UNDERCUT BANKS [1]	3 POOLS > 70cm [2]	0 OXBOWS, BACKWATERS [1]	
1 OVERHANGING VEGETATION [1]	1 ROOTWADS [1]	0 AQUATIC MACROPHYTES [1]	
0 SHALLOWS (IN SLOW WATER) [1]	1 BOULDERS [1]	3 LOGS OR WOODY DEBRIS [1]	
1 ROOTMATS [1]			

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: 15

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: 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 L	EROSION R		RIPARIAN WIDTH L	RIPARIAN WIDTH R		FLOOD PLAIN QUALITY L	FLOOD PLAIN QUALITY R	
☑	☑	NONE / LITTLE [3]	☐	☐	WIDE > 50m [4]	☐	☐	FOREST, SWAMP [3]
☑	☑	MODERATE [2]	☐	☐	MODERATE 10-50m [3]	☐	☐	SHRUB OR OLD FIELD [2]
☐	☐	HEAVY / SEVERE [1]	☑	☑	NARROW 5-10m [2]	☐	☐	RESIDENTIAL, PARK, NEW FIELD [1]
			☐	☐	VERY NARROW < 5m [1]	☐	☐	FENCED PASTURE [1]
			☐	☐	NONE [0]	☐	☐	OPEN PASTURE, ROWCROP [0]

L	R	
☐	☐	CONSERVATION TILLAGE [1]
☑	☑	URBAN OR INDUSTRIAL [0]
☐	☐	MINING / CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian Maximum 10: 4.5

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH
Check ONE (ONLY!)
- ☑ > 1m [6]
- ☐ 0.7-<1m [4]
- ☐ 0.4-<0.7m [2]
- ☐ 0.2-<0.4m [1]
- ☐ < 0.2m [0]

CHANNEL WIDTH
Check ONE (Or 2 & average)
- ☐ POOL WIDTH > RIFFLE WIDTH [2]
- ☐ POOL WIDTH = RIFFLE WIDTH [1]
- ☑ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY
Check ALL that apply
- ☐ 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
(circle one and comment on back)

Comments

Pool / Current Maximum 12: 1

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]

Comments

Riffle / Run Maximum 8: 0

6] GRADIENT (6.43 ft/mi)
DRAINAGE AREA (165 mi²)
- ☐ VERY LOW - LOW [2-4]
- ☐ MODERATE [6-10]
- ☐ HIGH - VERY HIGH [10-6]

%POOL: ____ %GLIDE: ____
%RUN: ____ %RIFFLE: ____

Gradient Maximum 10: 10

A] SAMPLED REACH

Check ALL that apply

METHOD

- [x] BOAT
- [ ] WADE
- [ ] L. LINE
- [ ] OTHER

STAGE

1st -sample pass-	2nd
☐ HIGH	☐
☐ UP	☐
☑ NORMAL	☐
☑ LOW	☐
☐ DRY	☐

DISTANCE

- [x] 0.5 Km
- [ ] 0.2 Km
- [ ] 0.15 Km
- [ ] 0.12 Km
- [ ] OTHER

_____ meters

CLARITY

1st --sample pass--	2nd
☐ < 20 cm	☐
☐ 20-<40 cm	☐
☑ 40-70 cm	☐
☐ > 70 cm/ CTB	☐
☐ SECCHI DEPTH	☐

CANOPY

- [x] > 85%- OPEN
- [ ] 55%-<85%
- [ ] 30%-<55%
- [ ] 10%-<30%
- [ ] <10%- CLOSED

pass 1st _____ cm

pass 2nd _____ cm

B] AESTHETICS

- ☐ NUISANCE ALGAE
- ☐ INVASIVE MACROPHYTES
- ☐ EXCESS TURBIDITY
- ☐ DISCOLORATION
- ☐ FOAM / SCUM
- ☐ OIL SHEEN
- ☐ TRASH / LITTER
- ☐ NUISANCE ODOR
- ☐ SLUDGE DEPOSITS
- ☐ CSOs/SSOs/OUTFALLS

C] RECREATION

POOL: ☐ AREA >100ft² ☐ DEPTH >3ft

D] MAINTENANCE

Circle some & COMMENT

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 H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

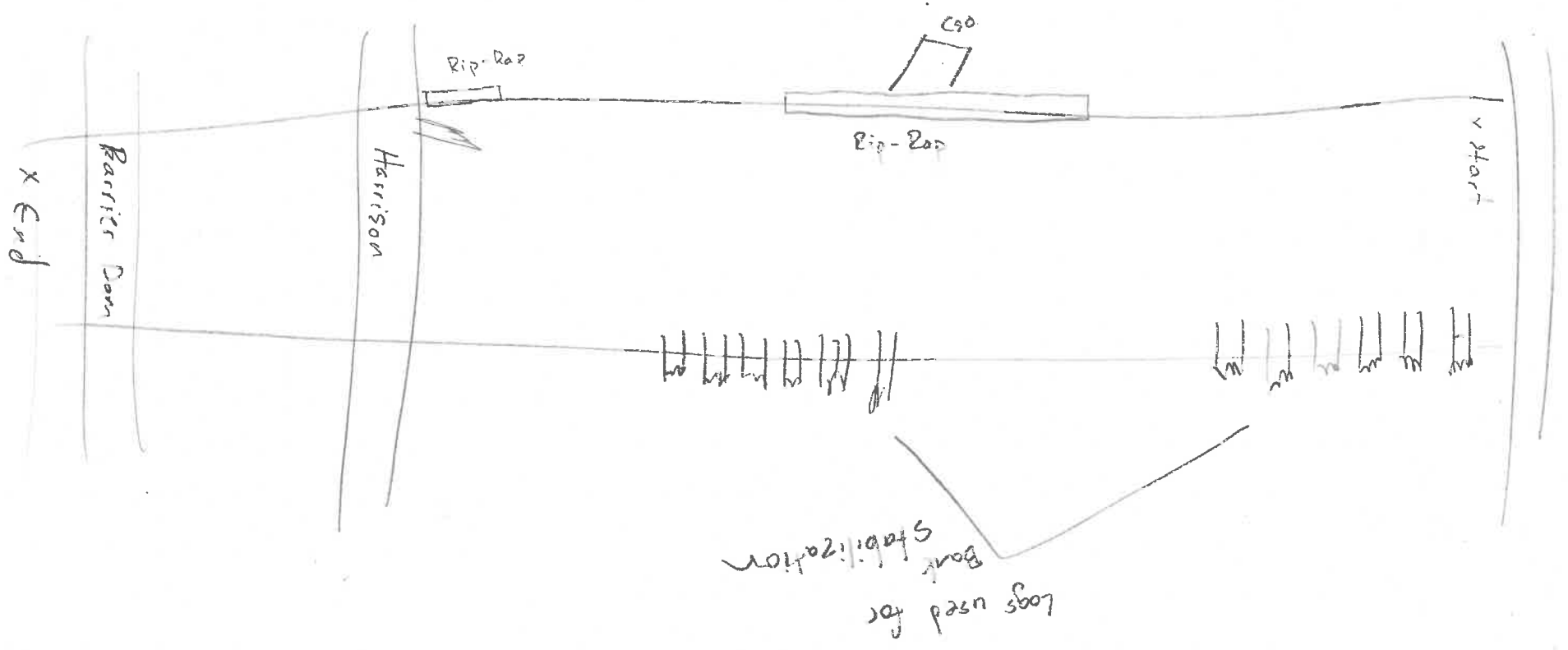
F] MEASUREMENTS

- $\bar{x}$ width
- $\bar{x}$ depth
- max. depth
- $\bar{x}$ bankfull width
- bankfull $\bar{x}$ depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Comment RE: Reach consistency/ Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

Stream Drawing:



Ohio EPA — Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 53.5

Stream & Location: Mill Creek lc U2f Mill Creek WWTP MC71 RM: 0.7 Date: 10/03/23

Scorers Full Name & Affiliation: MAS - MBI

River Code: 22-00 L- STORET #: Lat./Long. (NAD 83 - decimal °): 39.11209 / 84.34486 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
☐ ☐ BLDR /SLABS [10]			☐ ☐ HARDPAN [4]	X	
☐ ☐ BOULDER [9]	X		☐ ☐ DETRITUS [3]	1	
☐ ☐ COBBLE [8]	X		☐ ☐ MUCK [2]		
☐ ☑ GRAVEL [7]	X		☐ ☐ SILT [2]	X	
☑ ☐ SAND [6]	X		☐ ☐ ARTIFICIAL [0]	0	
☐ ☐ BEDROCK [5]			(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☑ 4 or more [2] ☐ 3 or less [0]

ORIGIN (Check ONE (Or 2 & average))	QUALITY	
☑ LIMESTONE [1]	SILT: ☐ HEAVY [-2] ☑ MODERATE [-1] ☐ NORMAL [0] ☐ FREE [1]	
☐ TILLS [1]	EMBEDDEDNESS: ☑ EXTENSIVE [-2] ☐ MODERATE [-1] ☐ NORMAL [0] ☐ NONE [1]	
☐ WETLANDS [0]		
☐ HARDPAN [0]		
☐ SANDSTONE [0]		
☐ RIP/RAP [0]		
☐ LACUSTURINE [0]		
☐ SHALE [-1]		
☐ COAL FINES [-2]		

Comments

Substrate Maximum 20: 13

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.

1 UNDERCUT BANKS [1]	3 POOLS > 70cm [2]	0 OXBOWS, BACKWATERS [1]	
1 OVERHANGING VEGETATION [1]	1 ROOTWADS [1]	0 AQUATIC MACROPHYTES [1]	
0 SHALLOWS (IN SLOW WATER) [1]	2 BOULDERS [1]	2 LOGS OR WOODY DEBRIS [1]	
1 ROOTMATS [1]			

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: 13

3] CHANNEL MORPHOLOGY
Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☑ MODERATE [2]
☐ LOW [2]	☐ FAIR [3]	☐ RECOVERING [3]	☐ LOW [1]
☑ NONE [1]	☑ POOR [1]	☑ RECENT OR NO RECOVERY [1]	

Comments

Channel Maximum 20: 5

4] BANK EROSION AND RIPARIAN ZONE
Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

L	R	EROSION	L	R	RIPARIAN WIDTH	L	R	FLOOD PLAIN QUALITY	L	R	
☑	☑	NONE / LITTLE [3]	☐	☐	WIDE > 50m [4]	☐	☐	FOREST, SWAMP [3]	☐	☐	CONSERVATION TILLAGE [1]
☐	☐	MODERATE [2]	☑	☐	MODERATE 10-50m [3]	☐	☐	SHRUB OR OLD FIELD [2]	☑	☑	URBAN OR INDUSTRIAL [0]
☐	☐	HEAVY / SEVERE [1]	☐	☑	NARROW 5-10m [2]	☐	☐	RESIDENTIAL, PARK, NEW FIELD [1]	☐	☐	MINING / CONSTRUCTION [0]
			☐	☐	VERY NARROW < 5m [1]	☐	☐	FENCED PASTURE [1]			
			☐	☐	NONE [0]	☐	☐	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!))
☑ > 1m [6]
☐ 0.7-<1m [4]
☐ 0.4-<0.7m [2]
☐ 0.2-<0.4m [1]
☐ < 0.2m [0]

CHANNEL WIDTH (Check ONE (Or 2 & average))
☐ POOL WIDTH > RIFFLE WIDTH [2]
☐ POOL WIDTH = RIFFLE WIDTH [1]
☑ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY (Check ALL that apply)
☐ TORRENTIAL [-1] ☑ SLOW [1]
☐ VERY FAST [1] ☐ INTERSTITIAL [-1]
☐ FAST [1] ☐ INTERMITTENT [-2]
☐ MODERATE [1] ☐ EDDIES [1]
Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current Maximum 12: 1

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
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☑ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run Maximum 8: 0

6] GRADIENT (6.52 ft/mi)
DRAINAGE AREA (105 mi²)

☐ VERY LOW - LOW [2-4]
☐ MODERATE [6-10]
☐ HIGH - VERY HIGH [10-6]

%POOL: %GLIDE: %RUN: %RIFFLE:

Gradient Maximum 10: 10

A] SAMPLED REACH

Check ALL that apply

METHOD

- [x] BOAT
- [ ] WADE
- [ ] L. LINE
- [ ] OTHER

STAGE

1st -sample pass- 2nd	
☐ HIGH	☐
☐ UP	☐
☑ NORMAL	☐
☐ LOW	☐
☐ DRY	☐

DISTANCE

- [x] 0.5 Km
- [ ] 0.2 Km
- [ ] 0.15 Km
- [ ] 0.12 Km
- [ ] OTHER

_____ meters

CLARITY

1st --sample pass-- 2nd	
☐ < 20 cm	☐
☐ 20-<40 cm	☐
☑ 40-70 cm	☐
☐ > 70 cm/ CTB	☐
☐ SECCHI DEPTH	☐

CANOPY

- [x] > 85%- OPEN
- [ ] 55%-<85%
- [ ] 30%-<55%
- [ ] 10%-<30%
- [ ] <10%- CLOSED

1st pass: _____ cm

2nd: _____ cm

Comment RE: Reach consistency/ Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

B] AESTHETICS

- ☐ NUISANCE ALGAE
- ☐ INVASIVE MACROPHYTES
- ☐ EXCESS TURBIDITY
- ☐ DISCOLORATION
- ☐ FOAM / SCUM
- ☐ OIL SHEEN
- ☐ TRASH / LITTER
- ☐ NUISANCE ODOR
- ☐ SLUDGE DEPOSITS
- ☐ CSOs/SSOs/OUTFALLS

C] RECREATION

POOL: AREA ☐ >100ft² DEPTH ☐ >3ft

D] MAINTENANCE

Circle some & COMMENT

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

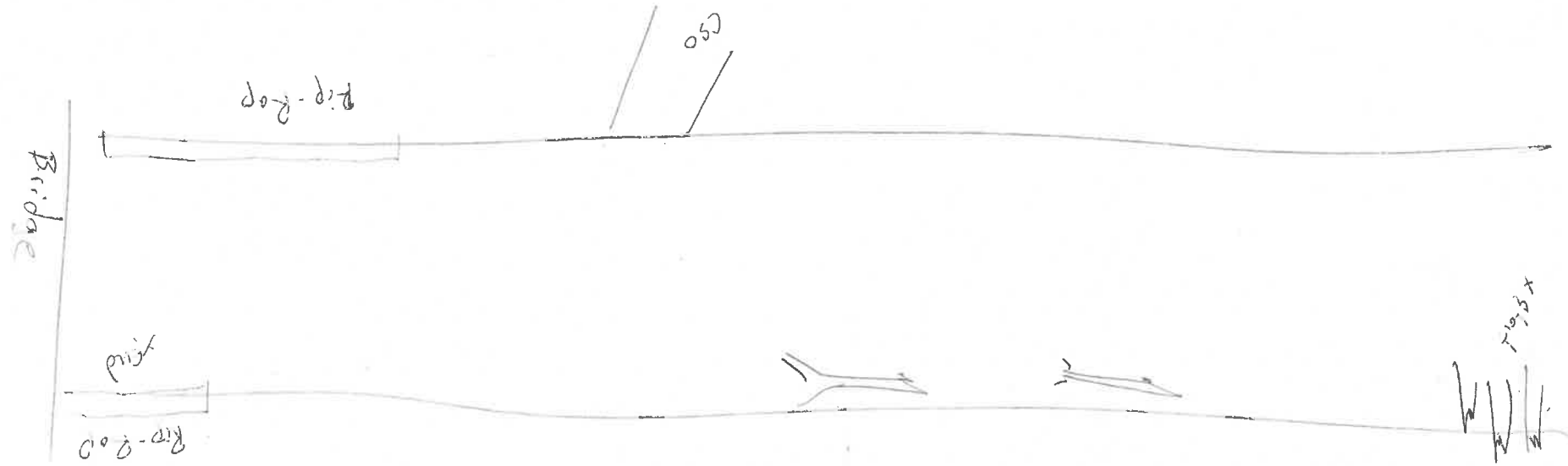
WWTP / CSO / NPDES / INDUSTRY
HARDENED / URBAN / DIRT&GRIME
CONTAMINATED / LANDFILL
BMPs-CONSTRUCTION-SEDIMENT
LOGGING / IRRIGATION / COOLING
BANK / EROSION / SURFACE
FALSE BANK / MANURE / LAGOON
WASH H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / 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 x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Ohio EPA — Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 60

Stream & Location: Mill Creek Dot Lick Run CSO (005) RM: 1.7 Date: 10/03/23
MC03

Scorers Full Name & Affiliation: MAS -> MBI

River Code: 23-001- ___ STORET #: _____ Lat./Long.: (NAD 83 - decimal °) 39.12233184, -84.54281 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
☐☐ BLDR /SLABS [10]			☐☐ HARDPAN [4]		
☐☐ BOULDER [9]	X		☐☐ DETRITUS [3]	X	
☐☐ COBBLE [8]	X		☐☐ MUCK [2]		
☐☑ GRAVEL [7]	X		☐☐ SILT [2]	X	
☑☐ SAND [6]	X		☐☐ ARTIFICIAL [0]	△	
☐☐ BEDROCK [5]			(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☑ 4 or more [2] ☐ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN	QUALITY	
☑ LIMESTONE [1]	☐ HEAVY [-2]	
☐ TILLS [1]	☑ MODERATE [-1]	SILT
☐ WETLANDS [0]	☐ NORMAL [0]	
☐ HARDPAN [0]	☐ FREE [1]	
☐ SANDSTONE [0]	☑ EXTENSIVE [-2]	EMBEDDEDNESS
☐ RIP/RAP [0]	☐ MODERATE [-1]	
☐ LACUSTURINE [0]	☐ NORMAL [0]	
☐ SHALE [-1]	☐ NONE [1]	
☐ COAL FINES [-2]		

Comments

Substrate 13 / 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.

1	UNDERCUT BANKS [1]	3	POOLS > 70cm [2]	0	OXBOWS, BACKWATERS [1]	☐	EXTENSIVE >75% [11]
1	OVERHANGING VEGETATION [1]	2	ROOTWADS [1]	0	AQUATIC MACROPHYTES [1]	☑	MODERATE 25-75% [7]
1	SHALLOWS (IN SLOW WATER) [1]	2	BOULDERS [1]	3	LOGS OR WOODY DEBRIS [1]	☐	SPARSE 5-<25% [3]
2	ROOTMATS [1]					☐	NEARLY ABSENT <5% [1]

AMOUNT — Check ONE (Or 2 & average)

Comments

Cover Maximum 20: 16

3] CHANNEL MORPHOLOGY
Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☑ MODERATE [2]
☑ LOW [2]	☑ FAIR [3]	☑ RECOVERING [3]	☐ LOW [1]
☐ NONE [1]	☑ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments

Channel Maximum 20: 9

4] BANK EROSION AND RIPARIAN ZONE
Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION L	EROSION R	RIPARIAN WIDTH L	RIPARIAN WIDTH R	FLOOD PLAIN QUALITY L	FLOOD PLAIN QUALITY R
☐ NONE / LITTLE [3]		☐ WIDE > 50m [4]		☐ FOREST, SWAMP [3]	☐ CONSERVATION TILLAGE [1]
☑ MODERATE [2]	☑ MODERATE [2]	☑ MODERATE 10-50m [3]	☑ MODERATE 10-50m [3]	☐ SHRUB OR OLD FIELD [2]	☑ URBAN OR INDUSTRIAL [0]
☐ HEAVY / SEVERE [1]		☐ NARROW 5-10m [2]		☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐ MINING / CONSTRUCTION [0]
		☐ VERY NARROW < 5m [1]		☐ FENCED PASTURE [1]	
		☐ NONE [0]		☐ 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 — Check ONE (ONLY!)	CHANNEL WIDTH — Check ONE (Or 2 & average)	CURRENT VELOCITY — Check ALL that apply	
☑ > 1m [6]	☐ POOL WIDTH > RIFFLE WIDTH [2]	☐ TORRENTIAL [-1]	☑ SLOW [1]
☐ 0.7-<1m [4]	☐ POOL WIDTH = RIFFLE WIDTH [1]	☐ VERY FAST [1]	☐ INTERSTITIAL [-1]
☐ 0.4-<0.7m [2]	☑ POOL WIDTH < RIFFLE WIDTH [0]	☐ FAST [1]	☐ INTERMITTENT [-2]
☐ 0.2-<0.4m [1]		☐ MODERATE [1]	☐ EDDIES [1]
☐ < 0.2m [0]		Indicate for reach - pools and riffles.	

Recreation Potential: Primary Contact / Secondary Contact (circle one and comment on back)

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
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☑ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☐ EXTENSIVE [-1]

Comments

Riffle / Run Maximum 8: 0

6] GRADIENT (6.75 ft/mi)
DRAINAGE AREA (143 mi²)

☐ VERY LOW - LOW [2-4] ☐ MODERATE [6-10] ☐ HIGH - VERY HIGH [10-6]

%POOL: %GLIDE: %RUN: %RIFFLE:

Gradient Maximum 10: 10

A] SAMPLED REACH

Check ALL that apply

METHOD

- [x] BOAT
- [ ] WADE
- [ ] L. LINE
- [ ] OTHER

STAGE

1st -sample pass- 2nd	
[ ] HIGH	[ ]
[ ] UP	[ ]
[x] NORMAL	[ ]
[x] LOW	[ ]
[ ] DRY	[ ]

DISTANCE

- [x] 0.5 Km
- [ ] 0.2 Km
- [ ] 0.15 Km
- [ ] 0.12 Km
- [ ] OTHER

_____ meters

CLARITY

1st --sample pass-- 2nd	
[ ] < 20 cm	[ ]
[ ] 20-<40 cm	[ ]
[x] 40-70 cm	[ ]
[ ] > 70 cm/ CTB	[ ]
[ ] SECCHI DEPTH	[ ]

1st _____ cm

pass

2nd _____ cm

CANOPY

- [ ] > 85%- OPEN
- [x] 55%-<85%
- [ ] 30%-<55%
- [ ] 10%-<30%
- [ ] <10%- CLOSED

Comment RE: Reach consistency/ Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

B] AESTHETICS

- [ ] NUISANCE ALGAE
- [ ] INVASIVE MACROPHYTES
- [ ] EXCESS TURBIDITY
- [ ] DISCOLORATION
- [ ] FOAM / SCUM
- [ ] OIL SHEEN
- [ ] TRASH / LITTER
- [ ] NUISANCE ODOR
- [ ] SLUDGE DEPOSITS
- [ ] CSOs/SSOs/OUTFALLS

C] RECREATION

POOL: AREA [ ] >100ft² DEPTH [ ] >3ft

D] MAINTENANCE

Circle some & COMMENT

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

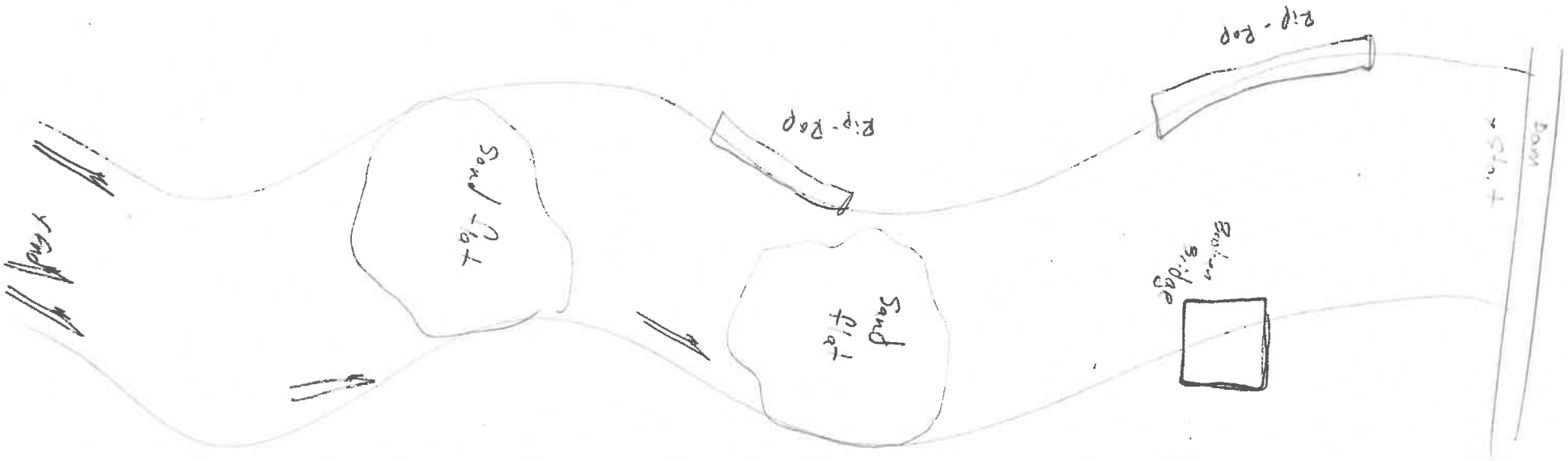
WWTP / CSO / NPDES / INDUSTRY
HARDENED / URBAN / DIRT&GRIME
CONTAMINATED / LANDFILL
BMPs-CONSTRUCTION-SEDIMENT
LOGGING / IRRIGATION / COOLING
BANK / EROSION / SURFACE
FALSE BANK / MANURE / LAGOON
WASH H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / 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 x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Ohio EPA Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 53.75

Stream & Location: Mill Creek Dsf Mill Creek Rd MU72 **RM:** 3.1 **Date:** 8/22/2023

Scorers Full Name & Affiliation: MAS -> MBI

River Code: 12-001- **STORET #:** **Lat./Long.:** 39.14424 / 84.54832 (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
☐ ☐ BLDR/SLABS [10]			☐ ☐ HARDPAN [4]	A	
☐ ☐ BOULDER [9]			☐ ☐ DETRITUS [3]		
☐ ☐ COBBLE [8]	A		☐ ☐ MUCK [2]		
☐ ☑ GRAVEL [7]	A	A	☐ ☐ SILT [2]	A	A
☑ ☐ SAND [6]	A	A	☐ ☐ ARTIFICIAL [0]		
☐ ☐ BEDROCK [5]			(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☑ 3 or less [0]

Check ONE (*Or 2 & average*)

ORIGIN
- ☑ LIMESTONE [1]
- ☑ TILLS [1]
- ☐ WETLANDS [0]
- ☐ HARDPAN [0]
- ☐ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTURINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY

SILT
- ☐ HEAVY [-2]
- ☑ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ FREE [1]

EMBEDDEDNESS
- ☑ EXTENSIVE [-2]
- ☑ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

Substrate 11.5 *Maximum 20*

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.

1	UNDERCUT BANKS [1]	1	POOLS > 70cm [2]	0	OXBOWS, BACKWATERS [1]
2	OVERHANGING VEGETATION [1]	1	ROOTWADS [1]	0	AQUATIC MACROPHYTES [1]
2	SHALLOWS (IN SLOW WATER) [1]	0	BOULDERS [1]	1	LOGS OR WOODY DEBRIS [1]
2	ROOTMATS [1]				

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* 11

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* 9.5

4] BANK EROSION AND RIPARIAN ZONE
Check ONE in each category for *EACH BANK* (*Or 2 per bank & average*)
River right looking downstream

EROSION

L	R	
☐	☑	NONE / LITTLE [3]
☑	☐	MODERATE [2]
☐	☐	HEAVY / SEVERE [1]

RIPARIAN WIDTH

L	R	
☐	☐	WIDE > 50m [4]
☑	☑	MODERATE 10-50m [3]
☐	☐	NARROW 5-10m [2]
☐	☐	VERY NARROW < 5m [1]
☐	☐	NONE [0]

FLOOD PLAIN QUALITY

L	R	
☐	☐	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* 5.75

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH
Check ONE (*ONLY!*)
- ☐ > 1m [6]
- ☐ 0.7-<1m [4]
- ☑ 0.4-<0.7m [2]
- ☐ 0.2-<0.4m [1]
- ☐ < 0.2m [0]

CHANNEL WIDTH
Check ONE (*Or 2 & average*)
- ☐ POOL WIDTH > RIFFLE WIDTH [2]
- ☐ POOL WIDTH = RIFFLE WIDTH [1]
- ☑ POOL WIDTH > RIFFLE WIDTH [0]

CURRENT VELOCITY
Check ALL that apply
- ☐ 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
(circle one and comment on back)

Comments

Pool / Current *Maximum 12* 4

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]

Comments

Riffle / Run *Maximum 8* 2

6] GRADIENT
(6.89 ft/mi) ☐ VERY LOW - LOW [2-4] ☐ MODERATE [6-10] ☐ HIGH - VERY HIGH [10-6]

DRAINAGE AREA (154 mi²)

%POOL: %GLIDE: %RUN: %RIFFLE:

Gradient *Maximum 10* 10

EPA 4520 06/16/06

A] SAMPLED REACH

Check ALL that apply

METHOD

- [ ] BOAT
- [x] WADE
- [ ] L. LINE
- [ ] OTHER

STAGE

1st -sample pass-		2nd
☐	HIGH	☐
☐	UP	☐
☑	NORMAL	☐
☑	LOW	☐
☐	DRY	☐

DISTANCE

- [ ] 0.5 Km
- [x] 0.2 Km
- [ ] 0.15 Km
- [ ] 0.12 Km
- [ ] OTHER

_____ meters

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

C] RECREATION POOL: AREA ☐ >100ft² DEPTH ☐ >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 Circle some & COMMENT

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 H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / HOME
ATMOSPHERE / DATA PAUCITY

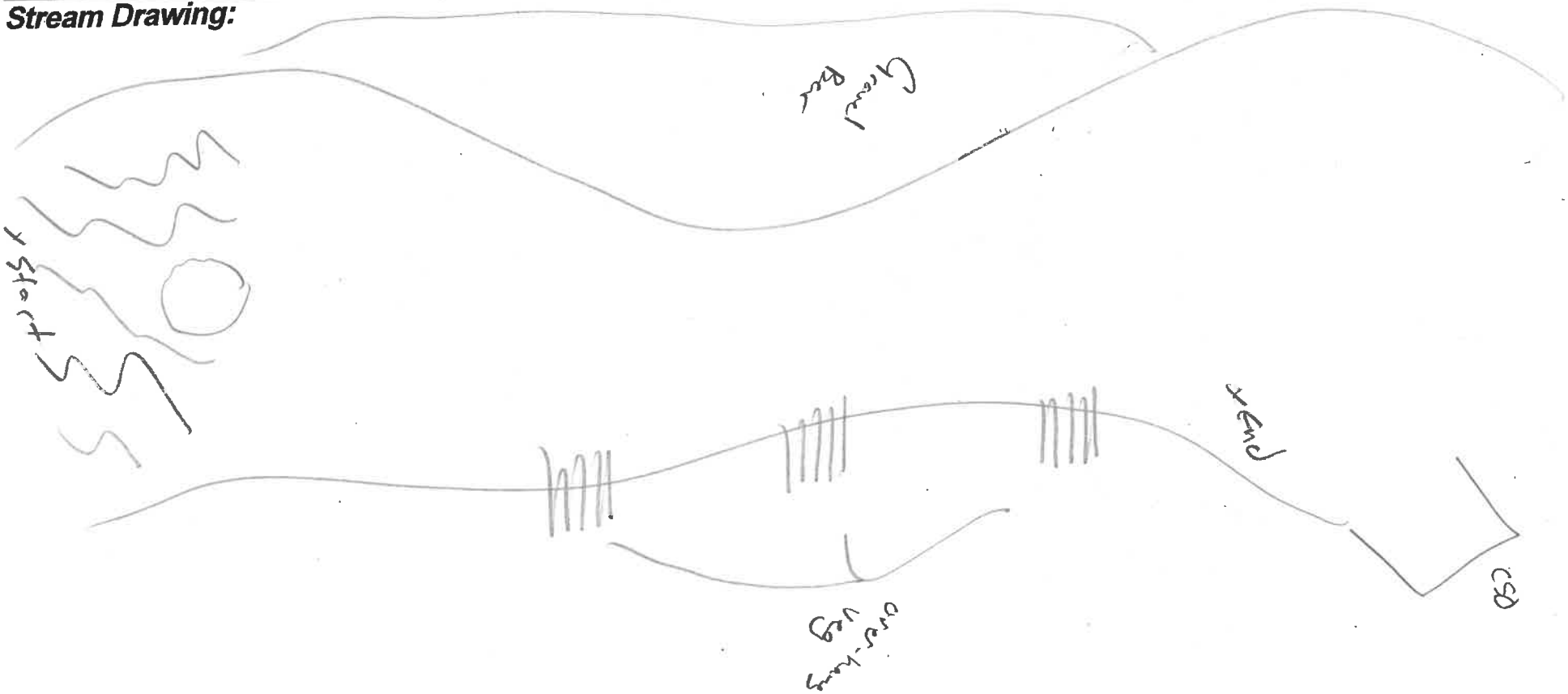
F] MEASUREMENTS

- $\bar{x}$ width
- $\bar{x}$ depth
- max. depth
- $\bar{x}$ bankfull width
- bankfull $\bar{x}$ depth
- W/D ratio
- bankfull max. depth
- floodprone x^2 width
- entrench. ratio

Legacy Tree:

Comment RE: Reach consistency/ Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

Stream Drawing:



Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 55

Stream & Location: Mill Creek Ust Mill Creek Rd MC73 **RM:** 3.5 **Date:** 8/22/2023

Scorers Full Name & Affiliation: MAS -> MBJ

River Code: 23-001- **STORET #:** **Lat./Long.:** 39.14904 84.54607 (NAD 83 - decimal °) 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
☐ ☐ BLDR/SLABS [10]			☐ ☐ HARDPAN [4]	X	
☐ ☐ BOULDER [9]			☐ ☐ DETRITUS [3]		
☐ ☐ COBBLE [8]	X	X	☐ ☐ MUCK [2]		
☑ ☐ GRAVEL [7]	X	X	☐ ☐ SILT [2]	X	X
☐ ☑ SAND [6]	X		☐ ☐ ARTIFICIAL [0]		
☐ ☐ BEDROCK [5]			(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☑ 3 or less [0]

ORIGIN	SILT	QUALITY
☑ LIMESTONE [1]		☐ HEAVY [-2]
☑ TILLS [1]		☑ MODERATE [-1]
☐ WETLANDS [0]		☐ NORMAL [0]
☐ HARDPAN [0]		☐ FREE [1]
☐ SANDSTONE [0]		☐ EXTENSIVE [-2]
☐ RIP/RAP [0]	EMBEDDEDNESS	☑ MODERATE [-1]
☐ LACUSTURINE [0]		☐ NORMAL [0]
☐ SHALE [-1]		☐ NONE [1]
☐ COAL FINES [-2]		

Substrate 12 *Maximum 20*

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.

1	UNDERCUT BANKS [1]	0	POOLS > 70cm [2]	0	OXBOWS, BACKWATERS [1]
2	OVERHANGING VEGETATION [1]	1	ROOTWADS [1]	0	AQUATIC MACROPHYTES [1]
2	SHALLOWS (IN SLOW WATER) [1]	0	BOULDERS [1]	2	LOGS OR WOODY DEBRIS [1]
3	ROOTMATS [1]				

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: 13

3] CHANNEL MORPHOLOGY
Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☑ MODERATE [2]
☑ LOW [2]	☑ FAIR [3]	☑ RECOVERING [3]	☐ LOW [1]
☐ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments

Channel Maximum 20: 10

4] BANK EROSION AND RIPARIAN ZONE
Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L / R)	RIPARIAN WIDTH (L / R)	FLOOD PLAIN QUALITY (L / R)
☑ ☑ NONE / LITTLE [3]	☐ ☐ WIDE > 50m [4]	☐ ☐ FOREST, SWAMP [3]
☑ ☑ MODERATE [2]	☐ ☐ MODERATE 10-50m [3]	☐ ☐ SHRUB OR OLD FIELD [2]
☐ ☐ HEAVY / SEVERE [1]	☑ ☑ NARROW 5-10m [2]	☐ ☐ RESIDENTIAL, PARK, NEW FIELD [1]
	☐ ☐ VERY NARROW < 5m [1]	☐ ☐ FENCED PASTURE [1]
	☐ ☐ NONE [0]	☐ ☐ OPEN PASTURE, ROWCROP [0]

L	R	
☐	☐	CONSERVATION TILLAGE [1]
☑	☑	URBAN OR INDUSTRIAL [0]
☐	☐	MINING / CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian Maximum 10: 4.5

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH Check ONE (ONLY!)
☐ > 1m [6]
☐ 0.7-<1m [4]
☑ 0.4-<0.7m [2]
☐ 0.2-<0.4m [1]
☐ < 0.2m [0]

CHANNEL WIDTH Check ONE (Or 2 & average)
☐ POOL WIDTH > RIFFLE WIDTH [2]
☐ POOL WIDTH = RIFFLE WIDTH [1]
☑ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY Check ALL that apply
☐ 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
(circle one and comment on back)

Comments

Pool / Current Maximum 12: 4

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
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☑ BEST AREAS 5-10cm [1]	☑ MAXIMUM < 50cm [1]	☑ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☑ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0]
			☑ EXTENSIVE [-1]

Comments

Riffle / Run Maximum 8: 1.5

6] GRADIENT (6.72 ft/mi)
DRAINAGE AREA (144 mi²)

☐ VERY LOW - LOW [2-4]
☐ MODERATE [6-10]
☐ HIGH - VERY HIGH [10-6]

%POOL: %GLIDE: %RUN: %RIFFLE:

Gradient Maximum 10: 10

EPA 4520 06/16/06

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

meters

CLARITY

1st --sample pass--	2nd
☐ < 20 cm	☐
☐ 20-<40 cm	☐
☑ 40-70 cm	☐
☐ > 70 cm/ CTB	☐
☐ SECCHI DEPTH	☐

1st pass _____ 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

POOL: AREA ☐ >100ft² DEPTH ☐ >3ft

D] MAINTENANCE

Circle some & *COMMENT*

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 H_20 / TILE / H_20 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 x^2 width
- entrench. ratio

Legacy Tree:

Comment RE: Reach consistency/ Is reach typical of steam?, *Recreation/* Observed - Inferred, *Other/* Sampling observations, Concerns, Access directions, etc.

Stream Drawing:

Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 71.75

Stream & Location: Mill Creek Dst 3 Ludlow Ave MC74 **RM:** 4.3 **Date:** 8/22/2023

Scorers Full Name & Affiliation: MAS -> MBI

River Code: 23-001- **STORET #:** **Lat./Long.:** 39.15735 84.53764 (NAD 83 - decimal °) 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
☐ ☐ BLDR/SLABS [10]			☐ ☐ HARDPAN [4]	2	
☐ ☐ BOULDER [9]	2		☐ ☐ DETRITUS [3]	2	
☐ ☐ COBBLE [8]	2	2	☐ ☐ MUCK [2]		
☒ ☐ GRAVEL [7]	2	2	☐ ☐ SILT [2]	2	
☐ ☒ SAND [6]	2		☐ ☐ ARTIFICIAL [0]		
☐ ☐ BEDROCK [5]			(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☒ 4 or more [2] ☐ 3 or less [0]

ORIGIN	QUALITY	
☒ LIMESTONE [1]	SILT: ☐ HEAVY [-2] ☒ MODERATE [-1] ☐ NORMAL [0] ☐ FREE [1]	
☒ TILLS [1]	EMBEDDEDNESS: ☐ EXTENSIVE [-2] ☒ MODERATE [-1] ☐ NORMAL [0] ☐ NONE [1]	
☐ WETLANDS [0]		
☐ HARDPAN [0]		
☐ SANDSTONE [0]		
☐ RIP/RAP [0]		
☐ LACUSTURINE [0]		
☐ SHALE [-1]		
☐ COAL FINES [-2]		

Substrate: 14 (Maximum 20)

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.

0	UNDERCUT BANKS [1]	2	POOLS > 70cm [2]	0	OXBOWS, BACKWATERS [1]
1	OVERHANGING VEGETATION [1]	1	ROOTWADS [1]	0	AQUATIC MACROPHYTES [1]
3	SHALLOWS (IN SLOW WATER) [1]	2	BOULDERS [1]	2	LOGS OR WOODY DEBRIS [1]
1	ROOTMATS [1]				

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)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☒ GOOD [5]	☒ RECOVERED [4]	☒ MODERATE [2]
☒ LOW [2]	☒ FAIR [3]	☐ RECOVERING [3]	☐ LOW [1]
☐ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments

Channel Maximum 20: 12

4] BANK EROSION AND RIPARIAN ZONE

Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L / R)	RIPARIAN WIDTH (L / R)	FLOOD PLAIN QUALITY (L / R)
☒ ☒ NONE / LITTLE [3]	☐ ☐ WIDE > 50m [4]	☒ ☐ FOREST, SWAMP [3]
☐ ☒ MODERATE [2]	☒ ☒ MODERATE 10-50m [3]	☐ ☐ SHRUB OR OLD FIELD [2]
☐ ☐ HEAVY / SEVERE [1]	☐ ☐ NARROW 5-10m [2]	☒ ☐ RESIDENTIAL, PARK, NEW FIELD [1]
	☐ ☐ VERY NARROW < 5m [1]	☐ ☐ FENCED PASTURE [1]
	☐ ☐ NONE [0]	☐ ☐ OPEN PASTURE, ROWCROP [0]

L	R	
☐	☐	CONSERVATION TILLAGE [1]
☐	☒	URBAN OR INDUSTRIAL [0]
☐	☐	MINING / CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian Maximum 10: 6.75

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH Check ONE (ONLY!)

☒ > 1m [6] ☐ 0.7-<1m [4] ☐ 0.4-<0.7m [2] ☐ 0.2-<0.4m [1] ☐ < 0.2m [0]

CHANNEL WIDTH Check ONE (Or 2 & average)

☐ POOL WIDTH > RIFFLE WIDTH [2] ☐ POOL WIDTH = RIFFLE WIDTH [1] ☒ POOL WIDTH > RIFFLE WIDTH [0]

CURRENT VELOCITY Check ALL that apply

☐ TORRENTIAL [-1] ☒ SLOW [1] ☐ VERY FAST [1] ☐ INTERSTITIAL [-1] ☐ FAST [1] ☐ INTERMITTENT [-2] ☒ MODERATE [1] ☒ EDDIES [1]

Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current Maximum 12: 9

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
☐ BEST AREAS > 10cm [2]	☒ MAXIMUM > 50cm [2]	☐ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☒ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☒ MOD. STABLE (e.g., Large Gravel) [1]	☒ LOW [1]
☐ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0] ☐ EXTENSIVE [-1]

Comments

Riffle / Run Maximum 8: 5

6] GRADIENT

(6.83 ft/mi)

DRAINAGE AREA (141 mi²)

☐ VERY LOW - LOW [2-4] ☐ MODERATE [6-10] ☐ HIGH - VERY HIGH [10-6]

%POOL: %GLIDE: %RUN: %RIFFLE:

Gradient Maximum 10: 10

EPA 4520 06/16/06

Comment RE: Reach consistency/ Is reach typical of steam?, *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

meters

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

1st pass _____ cm

2nd pass _____ cm

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

Circle some & *COMMENT*

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

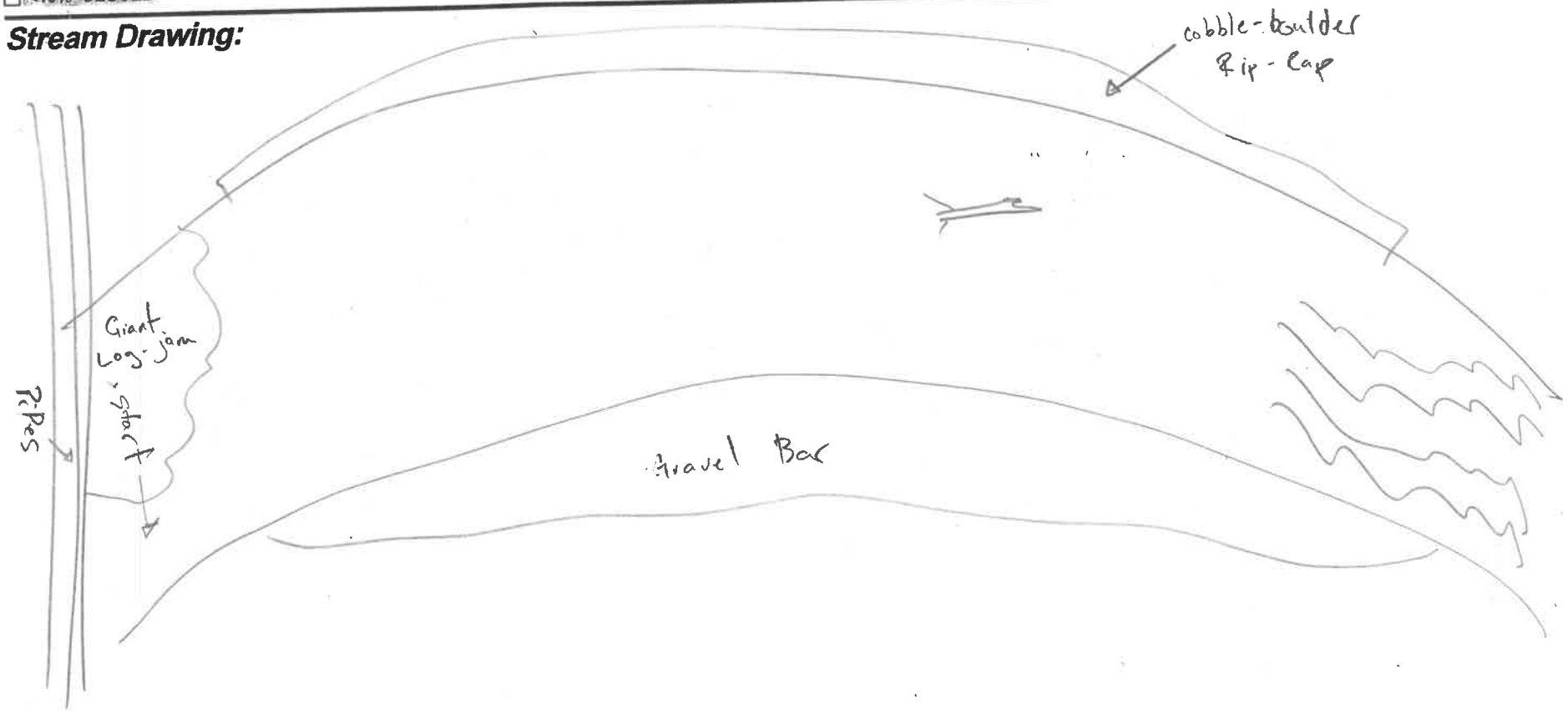
WWTP / CSO / NPDES / INDUSTRY
HARDENED / URBAN / DIRT&GRIME
CONTAMINATED / LANDFILL
BMPs-CONSTRUCTION-SEDIMENT
LOGGING / IRRIGATION / COOLING
BANK / EROSION / SURFACE
FALSE BANK / MANURE / LAGOON
WASH H_20 / TILE / H_20 TABLE
ACID / MINE / QUARRY / FLOW
NATURAL / WETLAND / STAGNANT
PARK / GOLF / LAWN / 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 x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Ohio EPA — Qualitative Habitat Evaluation Index and Use Assessment Field Sheet

QHEI Score: 58

Stream & Location: Mill Creek @ Salway Park MC75 **RM:** 5.1 **Date:** 8/22/2023

Scorers Full Name & Affiliation: MAS -> MBT

River Code: 23-001- **STORET #:** **Lat./Long.:** 39.16093 / 84.52737 (NAD 83 - decimal °) **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
☐ ☐ BLDR/SLABS [10]			☐ ☐ HARDPAN [4]	X	
☐ ☐ BOULDER [9]	X		☐ ☐ DETRITUS [3]		
☐ ☐ COBBLE [8]	X		☐ ☐ MUCK [2]		
☐ ☑ GRAVEL [7]	X		☐ ☐ SILT [2]	X	
☑ ☐ SAND [6]	X		☐ ☐ ARTIFICIAL [0]	X	
☐ ☐ BEDROCK [5]			(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☑ 4 or more [2] ☐ 3 or less [0]

ORIGIN	SILT / EMBEDDEDNESS	QUALITY
☑ LIMESTONE [1]		☑ HEAVY [-2]
☑ TILLS [1]		☑ MODERATE [-1]
☐ WETLANDS [0]		☐ NORMAL [0]
☐ HARDPAN [0]		☐ FREE [1]
☐ SANDSTONE [0]		☑ EXTENSIVE [-2]
☐ RIP/RAP [0]		☑ MODERATE [-1]
☐ LACUSTURINE [0]		☐ NORMAL [0]
☐ SHALE [-1]		☐ NONE [1]
☐ COAL FINES [-2]		

Comments

Substrate 13 / 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.

0	UNDERCUT BANKS [1]	3	POOLS > 70cm [2]	0	OXBOWS, BACKWATERS [1]
3	OVERHANGING VEGETATION [1]	1	ROOTWADS [1]	0	AQUATIC MACROPHYTES [1]
0	SHALLOWS (IN SLOW WATER) [1]	3	BOULDERS [1]	0	LOGS OR WOODY DEBRIS [1]
1	ROOTMATS [1]				

AMOUNT Check ONE (Or 2 & average)

☐ EXTENSIVE >75% [11] ☑ MODERATE 25-75% [7] ☐ SPARSE 5-<25% [3] ☐ NEARLY ABSENT <5% [1]

Comments

Cover 13 / Maximum 20

3] CHANNEL MORPHOLOGY

Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☑ MODERATE [2]
☐ LOW [2]	☑ FAIR [3]	☑ RECOVERING [3]	☐ LOW [1]
☑ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [1]	

Comments

Channel 9 / 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 (L / R)	RIPARIAN WIDTH (L / R)	FLOOD PLAIN QUALITY (L / R)
☑ ☐ NONE / LITTLE [3]	☐ ☐ WIDE > 50m [4]	☐ ☐ FOREST, SWAMP [3]
☑ ☐ MODERATE [2]	☐ ☐ MODERATE 10-50m [3]	☐ ☐ SHRUB OR OLD FIELD [2]
☐ ☐ HEAVY / SEVERE [1]	☑ ☑ NARROW 5-10m [2]	☐ ☑ RESIDENTIAL, PARK, NEW FIELD [1]
	☐ ☐ VERY NARROW < 5m [1]	☐ ☐ FENCED PASTURE [1]
	☐ ☐ NONE [0]	☐ ☐ OPEN PASTURE, ROWCROP [0]

L	R	
☐	☐	CONSERVATION TILLAGE [1]
☑	☐	URBAN OR INDUSTRIAL [0]
☐	☐	MINING / CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Comments

Riparian 5 / Maximum 10

5] POOL / GLIDE AND RIFFLE / RUN QUALITY

MAXIMUM DEPTH Check ONE (ONLY!)

☑ > 1m [6] ☐ 0.7-<1m [4] ☐ 0.4-<0.7m [2] ☐ 0.2-<0.4m [1] ☐ < 0.2m [0]

CHANNEL WIDTH Check ONE (Or 2 & average)

☐ POOL WIDTH > RIFFLE WIDTH [2] ☑ POOL WIDTH = RIFFLE WIDTH [1] ☐ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY Check ALL that apply

☐ TORRENTIAL [-1] ☑ SLOW [1] ☐ INTERSTITIAL [-1] ☐ FAST [1] ☐ INTERMITTENT [-2] ☐ MODERATE [1] ☐ EDDIES [1]

Indicate for reach - pools and riffles.

Recreation Potential
Primary Contact
Secondary Contact
(circle one and comment on back)

Comments

Pool / Current 8 / 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	RUN DEPTH	RIFFLE / RUN SUBSTRATE	RIFFLE / RUN EMBEDDEDNESS
☐ BEST AREAS > 10cm [2]	☐ MAXIMUM > 50cm [2]	☑ STABLE (e.g., Cobble, Boulder) [2]	☐ NONE [2]
☐ BEST AREAS 5-10cm [1]	☐ MAXIMUM < 50cm [1]	☐ MOD. STABLE (e.g., Large Gravel) [1]	☐ LOW [1]
☒ BEST AREAS < 5cm [metric=0]		☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]	☐ MODERATE [0] ☑ EXTENSIVE [-1]

Comments

Riffle / Run 0 / Maximum 8

6] GRADIENT

(7.0 ft/mi) ☐ VERY LOW - LOW [2-4] ☐ MODERATE [6-10] ☐ HIGH - VERY HIGH [10-6]

DRAINAGE AREA (139 mi²)

%POOL: %GLIDE: %RUN: %RIFFLE:

Gradient 10 / Maximum 10

EPA 4520 06/16/06

Comment RE: Reach consistency/ Is reach typical of steam?, *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

_____ meters

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

pass 1st _____ cm

pass 2nd _____ cm

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

Circle some & *COMMENT*

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 H_20 / TILE / H_20 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 x^2 width
- entrench. ratio

Legacy Tree:

Stream Drawing: