

Biological and Water Quality Study of Mill Creek
And Tributaries

Butler and Hamilton Counties, Ohio

Volume 1

April 15, 1994

OEPA Technical Report SWS/1993-12-9

prepared by

State of Ohio Environmental Protection Agency
Division of Surface Water
1800 Water Mark Drive
Columbus, Ohio 43266-0149

Water Quality Section
Nonpoint Source Management Section
40 South Main Street
Dayton, Ohio 45402

and

Ecological Assessment Section
1685 Westbelt Drive
Columbus, Ohio 43228

TABLE OF CONTENTS

Acknowledgements	iii
Plates	iv
Introduction	1
Summary	4
Conclusions	11
Recommendations	13
<i>Status of Aquatic Life Uses</i>	13
<i>Status of Non-aquatic Life Uses</i>	15
<i>Other Recommendations</i>	16
<i>Future Monitoring Concerns</i>	17
Study Area Description	18
Methods and Materials	25
Results and Discussion	28
<i>Pollutant Loadings</i>	28
<i>Chemical Water Quality</i>	32
<i>Physical Habitat</i>	53
<i>Biological Assessment: Macroinvertebrate Community</i>	58
<i>Biological Assessment: Fish Community</i>	62
<i>Fish Tissue</i>	68
<i>Sediment Chemistry</i>	70
<i>Sediment Toxicity</i>	79
<i>Spills</i>	80
Trend Assessment	81
<i>Chemical</i>	81
<i>Changes in Biological Community Performance: 1988 - 1992</i>	85
Stream Flow	88
References	89
Appendix Tables	Volume 2

NOTICE TO USERS

Ohio EPA adopted biological criteria into the Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) regulations in February 1990 (Effective May 1990). These criteria consist of numeric values for the Index of Biotic Integrity (IBI) and Modified Index of Well-Being (MIwb), both of which are based on fish, and the Invertebrate Community Index (ICI), which is based on macroinvertebrates. Criteria for each index are specified for each of Ohio's five ecoregions, and are further organized by organism group, index, site type, and aquatic life use designation. These criteria, along with the chemical and whole effluent toxicity evaluation methods, figure prominently in the assessment of Ohio's surface water resources.

Several documents support the adoption of the biological criteria by outlining the rationale for using biological information, the specific methods by which the biocriteria were derived and calculated, the field methods by which sampling must be conducted, and the process for evaluating results. These documents are:

Ohio Environmental Protection Agency. 1987a. Biological criteria for the protection of aquatic life: Volume I. The role of biological data in water quality assessment. Division of Water Quality Monitoring & Assessment, Surface Water Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1987b. Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Division of Water Quality Monitoring & Assessment, Surface Water Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1989a. Addendum to biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1989b. Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1990a. The use of biological criteria in the Ohio EPA surface water monitoring and assessment program. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

Rankin, E.T. 1989. The qualitative habitat evaluation index (QHEI): rationale, methods, and application. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

These documents and this document can be obtained by writing to:

Ohio EPA - DSW
Ecological Assessment Section
1685 Westbelt Drive
Columbus, Ohio 43228
(614) 777-6264

Acknowledgements

The following Ohio EPA staff are acknowledged for their significant contribution to this report.

Study Area Description - Hugh B. Trimble

Pollutant Loadings - Louise T. Snyder

Ambient Chemical Quality - Louise T. Snyder

Biological Assessment:

 Macroinvertebrate Community - Bernie Counts and Jack Freda

 Fish Community - Dave Altfater and Randy Sanders

Sediment - MaryAnne Mahr

Trend Assessment - MaryAnne Mahr

Spills - MaryAnne Mahr

NPDES Dischargers - Louise T. Snyder

Modeling Data - John Youger and Eric Piniero

Data Management - Dennis Mishne and Ed Rankin

TSD Coordinator - B. Diana Zimmerman

Reviewers - Chris Yoder, Graham Mitchell, Tom Winston, Jeff DeShon, Chuck McKnight,
Robin Corathers

This evaluation and report would not have been possible without the assistance of the study team (Jim Simpson, Mary Osika, Dave Okerbloom, Matt Walbridge, and Mike Zimmerman, DSW-WPC; Mike Proffitt, DGW; Elisabeth Rothschild, RCRA; and Dan Riestenberg, Ali Mozad, and Amy Gibbons, DERR), numerous other full and part time staff in the field and the chemistry analyses provided by the Ohio EPA, Division of Environmental Services. Appreciation is also extended to U.S. EPA- Newtown, U.S. Army Corps of Engineers, U.S. Geological Services, The Hamilton County Environmental Action Commission, City of Cincinnati Health Department, Mill Creek Valley Conservancy District and Cardinal Laboratories.

Biological and Water Quality Survey of Mill Creek
(Butler and Hamilton Counties, Ohio)

Ohio Environmental Protection Agency
Division of Surface Water
1800 WaterMark Drive
Columbus, Ohio 43266-0149

Introduction

During 1992, Ohio EPA conducted its first comprehensive water quality survey of the Mill Creek basin. Some prior biological sampling had been conducted in the basin during the late 1980s and early 1990s as well as chemical data from the late 1970s and early 1980s, but none of the previous sampling covered the extent of the 1992 survey. The 1992 Mill Creek study area extended from upstream, northeast of the City of Fairfield (RM 26.35) in Butler county to downstream, near the confluence with the Ohio River (RM 0.3, 472.5) in Hamilton County. The main channel of Mill Creek and several of its tributaries were sampled. Twenty-nine sites were selected for weekly water chemistry analyses, 21 sites were assessed for biological quality and 19 sites were sampled for sediment chemistry assessment during the 1992 survey (Table 1).

Specific objectives of this evaluation were to:

- 1) Evaluate the physical, chemical and biological water quality in the Mill Creek basin.
- 2) Evaluate the existing aquatic life use designations of Mill Creek and its tributaries and determine use designations for several undesignated streams.
- 3) Evaluate potential impacts from point source dischargers, combined sewer overflows, and nonpoint sources (i.e. old landfills, industrial sites).
- 4) Identify pollution sources not previously identified.

This survey was not designed to isolate individual dischargers or point sources through water quality assessment because the extent of those sources is so great within the lower 17 miles of the stream. The survey was designed to evaluate the water quality in sections or reaches of the creek. The findings of this evaluation may factor into regulatory actions taken by Ohio EPA (e.g. NPDES permits, Director's Orders), the Ohio Water Quality Standards (OAC 3745-1), and eventually be incorporated into the State Water Quality Management Plans, the Ohio Nonpoint Source Assessment, and the biennial Water Resource Inventory (305[b] report).

Table 1. Sampling locations in the Mill Creek study area, 1992.

Stream/ River Mile	Type of Sampling	Latitude/Longitude	Landmark	USGS 7.5 min. Quad. Map
<i>Mill Creek</i>				
26.35/26.4	C/F,B,S	39°22'44"/84°28'44"	Liberty-Fairfd Rd.	Trenton, OH
24.64	S	39°21'43"/84°29'47"	Hamtn-Tylsvil. Rd.	Trenton, OH
19.05/19.1	C/F,B	39°18'18"/84°26'07"	Windisch Rd.	Glendale, OH
17.61/17.6	C/F,B	39°17'03"/84°25'58"	Kemper Rd.	Glendale, OH
16.57	C,S/F,B,FT	39°16'06"/84°25'56"	Sharon Rd.	Glendale, OH
14.75/14.8	C/F,B,S	39°14'47"/84°25'44"	Formica entrance	Cincinnati E., OH
13.89	S	39°14'14"/84°26'22"	Upst G.E. Trib.	Cincinnati E., OH
13.72	S	39°14'07"/84°26'26"	Adj. Cincin. Drum	Cincinnati E., OH
13.35/13.2/13.13	C/F,B/S	39°13'45"/84°26'46"	West Columbia Rd.	Cincinnati E., OH
11.73	C	39°12'43"/84°27'15"	Galbraith Rd.	Cincinnati E., OH
9.97	C	39°12'16"/84°28'15"	Vine St.	Cincinnati E., OH
8.92/9.02	C/S	39°11'56"/84°29'18"	North Bend Rd.	Cincinnati E., OH
8.7	F,B	39°11'48"/84°29'22"	State Route 561	Cincinnati E., OH
8.38	S	39°11'31"/84°29'21"	Ridgewood Arsenal	Cincinnati E., OH
7.8/7.86/7.85	F, B,FT/S/C	39°11'07"/84°29'45"	Center Hill Rd.	Cincinnati E., OH
6.53	C	39°10'19"/84°30'21"	Spring Grove Ave.	Cincinnati W.,OH
5.85	C	39°09'50"/84°30'39"	Mitchell Ave.	Cincinnati W.,OH
5.2/5.1/4.9	S/F,B/C	39°09'44"/84°31'24"	Salway Park	Cincinnati W.,OH
3.1/2.9	F,B/C,S	39°08'39"/84°32'52"	Upst. Hopple St.	Cincinnati W.,OH
0.51/0.5	C/S	39°06'27"/84°32'41"	Gest St.	Covington, KY
0.3	F,B,FT	39°06'20"/84°32'42"	Upst. Barrier Dam	Covington, KY
<i>East Fork Mill Creek</i>				
4.7/4.69	F,B/C	39°20'00"/84°23'30"	Barret Rd.	Glendale, OH
3.8/3.78	F,B/C	39°19'50"/84°24'22"	Station Rd.	Glendale, OH
1.9/1.85	F,B/C,S	39°19'47"/84°25'36"	Allen Rd.	Glendale, OH
0.8/0.77	F,B/C	39°17'55"/84°25'47"	Cresentville Rd.	Glendale, OH
0.3	F	39°17'32"/84°25'51"	Dst. Lowhead Dam	Glendale, OH
0.1/0.01	S,B/C	39°17'23"/84°26'01"	Mouth	Glendale, OH
<i>West Fork Mill Creek</i>				
4.5/4.45/4.4	F,B,/S/C	39°15'14"/84°28'14"	Riddle Rd.	Glendale, OH
2.0	F,B,C,S	39°13'49"/84°27'26"	Gardner Park	Cincinnati E., OH
1.0	F,B	39°13'15"/84°27'23"	Dst. I-75 (S)	Cincinnati E., OH
0.2/0.1	F,B,C/S	39°12'48"/84°27'34"	Dexter Ave.	Cincinnati E., OH

Table 1 (continued). Sampling locations in the Mill Creek study area, 1992.

Stream/ River Mile	Type of Sampling	Latitude/Longitude	Landmark	USGS 7.5 min. Quad. Map
<i>Sharon Creek</i>				
0.2	F,B	39°15'37"/84°25'25"	Exon Ave.	Glendale, OH
0.01	C	39°15'29"/84°25'32"	Mouth	Glendale, OH
<i>Town Run</i>				
0.7	C	39°16'26"/84°26'41"	Chester Rd.	Glendale, OH
<i>Cooper Creek</i>				
3.64	C	39°13'09"/84°23'32"	Plainfield Rd.	Cincinnati E., OH
0.2	C	39°14'17"/84°25'58"	Ust. of Mouth	Cincinnati E., OH
<i>Bloody Run</i>				
0.31	C	39°10'57"/84°29'33"	Vine St.	Cincinnati E., OH
<i>Ross Run</i>				
0.01	C	39°10'14"/84°30'22"	Mouth	Cincinnati W., OH
<i>Winton Ridge Tributary</i>				
1.81	S	39°11'28"/84°31'18"	Upst. Dutch Colony	Cincinnati W., OH

C - water chemistry
 S - sediment chemistry
 B - benthos
 F - fish
 FT - fish tissue

Summary of Results

Aquatic Life Use Designations

Mill Creek

- Under the existing aquatic life use designations of Warmwater Habitat (WWH) for river miles 26.4 through 19.1, Mill Creek exhibits both full attainment and non-attainment of its use designation (Table 2). Non-attainment was documented at river mile 19.1. Channel modifications were documented from river mile 24.64 through 8.38 which influenced the aquatic communities in this region. From river mile 17.6 through 0.3 Mill Creek is presently designated Limited Warmwater Habitat (LWH). Limited Warmwater Habitat was a designation temporarily assigned in 1978 to streams not meeting specific Warmwater Habitat criteria. Variances from some of the individual chemical criteria regulated within the State of Ohio Water Quality Standards (OAC 3745-1) were assigned on a temporary basis due to extreme instream chemical conditions. Once streams designated LWH undergo use attainability analyses, a redesignation will be given based on current aquatic life classification. The designation of Limited Warmwater Habitat will no longer be assigned to any body of water as per OAC 3745-1.
- Under the **proposed** aquatic life use designation of WWH for river miles (RM) 17.6 through 8.7, Mill Creek is not meeting its designated use. Physically, the stream channel is capable of supporting the criteria representative of the WWH use designation but due to chemical and biological criteria violations, the designation is not being attained.
- The use designation of **Modified Warmwater Habitat (MWH)** has been **proposed** for RM 7.8 to 0.0 due to permanent stream channel modifications. Biologically and chemically the stream is degraded, but under the modified channel conditions, this section of the stream will not support viable, reproducing warmwater biological communities nor will it meet the goals of the Clean Water Act. Of the 27 miles of stream sampled, 2.3 miles are **fully** attaining the designated use and 24.7 river miles are **not** attaining.

East Fork Mill Creek

- East Fork Mill Creek is currently fully attaining its aquatic life use designation of Warmwater Habitat (WWH) from river miles 4.7 to 1.9. Downstream from the Butler County Upper Mill Creek Wastewater Treatment Plant, the stream is not attaining its designated use. Several elevations and violations of both chemical and biological WWH criteria were documented in this lower reach of the stream. Full attainment of the aquatic life use designation was documented in 3.3 river miles of East Fork Mill Creek surveyed. Non-attainment was reported for 1.5 miles surveyed.

West Fork Mill Creek

- The entire segment of West Fork Mill Creek sampled during the 1992 survey (RM 4.7-0.1) was not attaining its designated use of WWH. Violations of both biological and chemical WWH criteria were documented during this survey and biological survey work conducted during 1991 (Ohio EPA 1992). The highest concentrations of lead measured in sediments during the Mill Creek survey were collected from West Fork Mill Creek.

Sharon Creek

- Very limited sampling was conducted in Sharon Creek during the survey (one site each for biological and chemical sampling). Sharon Creek exhibited non-attainment of the WWH aquatic life use designation. Violations of the fish IBI criterion and some chemical criteria were documented.

Table 2. Aquatic life use attainment status for the existing and proposed Warmwater Habitat (WWH), Limited Warmwater Habitat (LWH), Modified Warmwater Habitat (MWH) use designations in Mill Creek based on data collected during July-October, 1992.

RIVER MILE Fish/Invert.	IBI	Modified Iwb	ICI ^a	QHEI ^b	Attainment Status	Comment
<i>Mill Creek (1992)</i>						
<i>Interior Plateau - WWH Use designation (existing)</i>						
26.4/26.4	38 ^{ns}	NA	MG	64	FULL	Liberty-Fairfield Rd.
19.1/19.1	<u>25*</u>	6.4*	F	60	NON	Windisch Rd.
<i>Interior Plateau - LWH/WWH Use designation (existing/proposed)</i>						
17.6/17.6	<u>21*</u>	<u>5.7*</u>	F	63	NON	Kemper Rd.
16.5/16.6	<u>24*</u>	<u>5.7*</u>	P	63	NON	Sharon Rd.
14.8/14.8	<u>20*</u>	<u>4.8*</u>	P	60	NON	Formica Entrance
13.2/13.3	<u>20*</u>	<u>4.3*</u>	P	61	NON	West Columbia Rd.
8.7/8.7	<u>25*</u>	<u>5.7*</u>	P	66	NON	State Route 561
<i>Interior Plateau - LWH/MWH Use designation (existing/proposed)</i>						
7.8/7.8	<u>24</u>	6.3	P	65	NON	Center Hill Rd.
5.1/5.1	<u>17*</u>	<u>4.9*</u>	P	52	NON	Salway Park
3.1/3.1	<u>12*</u>	<u>2.3*</u>	VP	40	NON	Upst. Hopple St.
0.3/0.3	<u>21*</u>	6.8	VP	26	NON	Upst. Barrier Dam
<i>East Fork Mill Creek (1992)</i>						
<i>Interior Plateau - WWH Use designation (existing)</i>						
4.7/4.7	40	NA	MG	74	FULL	Barret Rd.
3.8/3.9	40	NA	MG	72	FULL	Station Rd.
1.9/1.9	40	NA	MG	61	FULL	Allen Rd.
0.8/0.8	<u>24*</u>	NA	F	61	NON	Crescentville Rd.
0.3/0.1	<u>26*</u>	NA	F	66	NON	Dst. Lowhead Dam

* - significant departure from biocriteria (>4 IBI units or >0.5 Iwb units); poor and very poor results are underlined.

^{ns} - nonsignificant departure from biocriteria (≤4 IBI; ≤0.5 Iwb units).

^a - Narrative evaluation used in lieu of ICI (E=Exceptional; G=good; MG=Marginally good; F=Fair; P=Poor; VP=Very Poor).

^b - Qualitative Habitat Evaluation Index (QHEI) values from Rankin 1989.

^c - Value in parentheses is Modified Warmwater Habitat for impounded areas.

^d - Modified Warmwater Habitat for channel modified areas.

NA - Headwater site: MIwb is not applicable.

Table 2. (continued)

RIVER MILE Fish/Invert.	IBI	Modified Iwb	ICI ^a	QHEI ^b	Attainment Status	Comment
<i>West Fork Mill Creek (1992)</i>						
<i>Interior Plateau - WWH Use designation (existing)</i>						
4.5/4.7	<u>22</u> *	6.4*	F	76	NON	Riddle Road
2.0/2.0	<u>24</u> *	6.6*	P	71	NON	Gardner Park
1.0/1.0	<u>21</u> *	6.0*	F	70	NON	Dst. I-75 (S)
0.2/0.2	<u>17</u> *	<u>5.6</u> *	F	60	NON	Dexter Avenue
<i>Sharon Creek (1992)</i>						
<i>Interior Plateau - WWH Use designation (existing)</i>						
0.2/0.3	<u>26</u> *	NA	MG	62	NON	Exon Avenue

Ecoregion Biocriteria: Interior Plateau (IP)

INDEX - Site Type	WWH	EWB	MWH ^d
IBI - Headwaters/Wading	40	50	24
IBI - Boat	38	48	24 (30) ^c
Mod. Iwb - Wading	8.1	9.4	6.2
Mod. Iwb - Boat	8.7	9.6	5.8 (6.6) ^c

* - significant departure from biocriteria (>4 IBI units or >0.5 Iwb units); poor and very poor results are underlined.

^{ns} - nonsignificant departure from biocriteria (≤4 IBI; ≤0.5 Iwb units).

^a - Narrative evaluation used in lieu of ICI (E=Exceptional; G=good; MG=Marginally good; F=Fair; P=Poor; VP=Very Poor).

^b - Qualitative Habitat Evaluation Index (QHEI) values from Rankin 1989.

^c - Value in parentheses is Modified Warmwater Habitat for impounded areas.

^d - Modified Warmwater Habitat for channel modified areas.

NA - Headwater site; MIwb is not applicable.

Town Run, Cooper Creek, G.E. Tributary, Bloody Run, Ross Run and Winton Ridge Tributary

- Biological assessment of these streams was not conducted during the 1992 Mill Creek survey. Attainment status of aquatic life use designations is not available for these tributaries at this time.

West Fork

- West Fork was neither biologically nor chemically assessed during the 1992 survey due to the extent of permanent concrete revetments. It was biologically evaluated during 1991 and found to be severely degraded (Ohio EPA 1992). Not only has the stream channel been permanently concreted through the jurisdictional region of the City of Cincinnati, but the normal flow of the stream has been diverted to enter into the combined sewer system and is directed to the MSD Mill Creek WWTP. During field reconnaissance prior to the survey, it was noted that the City of Cincinnati asphalt plant has heavily impacted the banks of West Fork near the confluence with Mill Creek by dumping old asphalt, sealant and trash on the right bank of the stream. Most of this material was above the cemented area of the banks. Also noted during reconnaissance was the presence of several huge cable spools which a company near the most downstream railroad crossing had dumped into the stream channel.

Chemical Water Quality

Mill Creek

- Exceedences of the Primary Contact Recreation criteria for fecal coliform and *E. coli* (>20000/100ml was the highest value measured for both parameters) were detected at virtually every chemical sampling site (Table 4).
- Dissolved oxygen (D.O.) violations occurred at river miles 2.90 and 0.51. Extremely high D.O. readings recorded during the day at river miles 6.53 and 5.85 were indicative of heavy algal growth and subsequent photosynthetic/respiration activity which causes oxygen depletion during the night. Datasonde readings from Mill Creek at river miles 16.57, 14.74, and 14.06 also recorded violations of WWH criterion for dissolved oxygen.
- Raw sewage and elevated levels of ammonia-N in exceedence of numerical criteria for prevention of chronic toxicity were documented at RMs 6.53, 5.85, and 4.9. Elevated levels of ammonia, phosphorus and nitrate-nitrite were also recorded from RMs 17.61 (downstream from East Fork Mill Creek) and 16.57 (downstream from Town Run) (Table 4).
- Total suspended solids concentrations were consistently higher at RM 9.97 which was downstream of bridge replacement construction at Anthony Wayne Ave.; this may have accounted for the elevated concentrations.
- Exceedences of water quality criteria were documented for selenium at RM 16.57, cyanide at RM 11.73 and copper at RMs 4.9, 2.90, 0.51.
- Elevated levels of lead in exceedence of numerical criteria for prevention of chronic toxicity were documented in the lower reaches of the mainstem at RMs 7.85, 6.53, 5.85, 4.90, 2.90, and 0.51.
- The seven sites (RMs 16.57, 13.35, 8.92, 7.85, 5.85, 2.90, and 0.51) sampled for organic compounds experienced exceedences of Ohio Water Quality Standards for various

organochlorine pesticides, including DDT and its metabolites. Several other organic chemicals were also detected in the water samples from these sites.

East Fork Mill Creek

- No elevated concentrations or exceedences of chemical water quality criteria were detected at river miles 4.69 and 3.78. These sites bracket Skinner Landfill, a superfund site.
- River miles 1.85 and 0.77 bracket the Butler County Upper Mill Creek WWTP. Violations of water quality criteria for dissolved oxygen, ammonia, selenium and various pesticides were exhibited at river mile 0.77, downstream from the plant. Elevated concentrations of phosphorus, nitrate-nitrite nitrogen, carbonaceous biochemical oxygen demand (CBOD₅) and zinc were also recorded at river mile 0.77. River mile 1.85 did not exhibit any elevations or exceedences of chemical parameters. An expansion and upgrade of the Upper Mill Creek WWTP (resulting from negotiations with Ohio EPA) was completed in September 1993 and the violations documented during the 1992 survey are not expected from the upgraded plant.
- Exceedences of the Primary Contact Recreational Use Criteria for fecal coliform and *E. coli* existed at all sites from river mile 1.85 to 0.01 (>20000/100ml was the highest documented). The most elevated levels were documented at river mile 0.01, just downstream from a sewer line crossing in the stream bed. Investigation during October 1993 by the Hamilton County Metropolitan Sewer District discovered the stream had eroded the bed under the sewer line causing leakage of sewage into East Fork Mill Creek. The Metropolitan Sewer District repaired the sewer line during the Fall of 1993.

West Fork Mill Creek

- Violations of the WWH criterion for lead were documented at RM 2.0. Possible lead contamination may be migrating to the stream from a former industry which disposed of lead sulfate sludge on-site into shallow pits and directly onto the ground surface. Other sources may also have contributed to the violations (i.e., CSOs, an old car battery and old auto parts observed in the general vicinity, general urban runoff).
- Numerous violations of water quality criteria were noted at RM 0.19 including dissolved oxygen, ammonia, fecal coliform, *E. coli*, lead and various organochlorine pesticides, including DDT. The highest ammonia concentrations (i.e., 21.4 mg/l being the highest) in the survey were recorded from this site. Several CSOs and two closed landfills are located in the general area.

Sharon Creek

- Exceedences of the Primary Contact Recreation criteria for fecal coliform and *E. coli* were documented from Sharon Creek. Elevated concentrations of total suspended solids were also noted and one cyanide value exceeded the WWH criterion; however, no source of contamination was determined.

Town Run

- Elevated levels of ammonia, phosphorus, fecal coliform, *E. coli*, nitrate-nitrite nitrogen, and low dissolved oxygen levels were documented in Town Run at RM 0.70. The sampling location was 0.22 river miles downstream from the Glendale WWTP discharge.

Cooper Creek

- No exceedences of chemical water quality criteria were documented in Cooper Creek during the 1992 survey. Elevated levels of cyanide and conductivity were noted on separate sampling events at RM 0.2.

Bloody Run

- Several elevations and criteria violations of fecal coliform, *E. coli*, dissolved oxygen, organochlorine pesticides, other pesticides, copper, and volatile organic compounds (VOCs) were documented from Bloody Run. A direct permitted industrial discharge is located on Bloody Run and combined sewers with overflow points receive waste from several industries in the area .

Ross Run

- Elevated levels of ammonia, organochlorine pesticides, zinc, other pesticides, VOCs and semi-volatile organic compounds (SVOCs) were detected in the water samples. Oil and grease were visible in the creek during most sampling events. Sampling was conducted in an industrial area where several combined sewer overflow points were located.

Sediment Chemistry**Mill Creek**

- Sediment assessment was based on the method of evaluation in Kelly and Hite (1984). Categories for classification are: non-elevated, slightly elevated, elevated, highly elevated and extremely elevated. Sediment metal chemistry results indicated several sites containing extremely elevated concentrations for a variety of metals. Elevated to extremely elevated levels of lead were detected from RM 16.57 to 0.5. Zinc concentrations ranged from slightly elevated to extremely elevated at eleven of the thirteen sites sampled. The site sampled near Salway Park at RM 5.2 exhibited the most numerous highly elevated and extremely elevated concentration of metals, including copper, cadmium, chromium, lead and zinc. River Mile 2.90, upstream from Hopple Street, had sediments with highly elevated to extremely elevated concentrations of copper, lead and zinc. Highly elevated to extremely elevated levels of lead and zinc were recorded from RM 0.5 near Gest Street.
- Organic compounds were detected at 89% of the sediment sites. Eighty-four percent of the sites revealed some level of organochlorine pesticide concentration. Highly elevated levels of DDT were detected at RM 0.5. Salway Park (RM 5.2) exhibited the most abundant number of volatile organic compounds. Aromatic hydrocarbons appeared from RM 14.8 to 0.5. No detectable concentrations of volatile, semi-volatile organic compounds, and pesticides were found from the background sites at RMs 26.40 and 24.6.
- Two PCB aroclors were detected in the sediments of Mill Creek. Polychlorinated biphenyl (PCB) 1248 first appeared at RM 13.13 in extremely elevated concentrations and was detected in highly elevated levels from RM 9.02 to 2.90. Aroclor 1260 was detected at a highly elevated concentration at Hopple Street, RM 2.90, yet was below chemical analysis detection at all other sediment sites sampled.

West Fork Mill Creek

- Lead concentrations in West Fork Mill Creek ranged from highly elevated to extremely elevated in all the sediment sites sampled. The highest level (8870 ppm) recorded in the entire Mill

Creek survey was taken upstream of Riddle Road from RM 4.45. This is also the second highest value recorded in the Ohio EPA sediment database for the entire State of Ohio. However, the highest concentration in the Ohio EPA database resulted from a stream sediment sample taken directly downstream from a metal plating industry discharge point. No direct source of contamination has been determined at the West Fork Mill Creek site. No known landfills, CSOs or direct discharges with lead concentrations are located in the area. Several culverts with foul smelling discharges were noted during the survey on the left bank of the stream upstream from Riddle Road.

Biological Quality

Mill Creek

- Fish communities within the Mill Creek were dominated by pollution tolerant species. Only one sampling location in the upper reaches of the mainstem of Mill Creek at RM 26.4 exhibited a fish community in the marginally good range of the Index of Biotic Integrity (IBI). The remainder of the river miles sampled had severely degraded fish communities.
- The physical condition of fish in Mill Creek was evaluated by recording gross DELT (deformities, fin erosion, lesions/ulcers and tumors) external anomalies. Biosurvey results throughout the State of Ohio indicate that a high rate of anomalies is an accurate indication of toxic pollution stress. The percent of anomalies was relatively high within the segment of Mill Creek impacted by combined sewer overflows. Of particular note was the site at RM 13.2 which had the highest level of anomalies (23.6%) recorded in the Mill Creek basin. This sampling location was located 0.5 miles downstream from a significant raw sewage discharge and was in the vicinity of a superfund site; two other potential hazardous waste sites and an area of concentrated industrial activity.
- Macroinvertebrate community results echoed the results of the fish biosurvey. The sampling site at RM 26.4 exhibited a marginally good macroinvertebrate community. Assessment in the urban and industrialized areas of Mill Creek indicated declining quality with poor to very poor macroinvertebrate communities being documented. The poorest quality invertebrate communities were collected from the lower two sampling sites (RM 3.1 and 0.3).
- Fish tissue samples were collected from representatives of four species at three locations in Mill Creek and analyzed for pesticides, PCBs, metals, semivolatile organic compounds and percent lipid content. Two PCB aroclors (1248 and 1260) were detected from eight samples. Three whole body samples from RMs 7.8 and 0.3 exceeded the FDA action level of 2.0 ppm for total PCBs in edible portions. Four of the eight samples from RMs 7.8 and 0.3 had PCB levels in violation of Ohio Water Quality Standards (0.64 ppm of any whole sample). All of the nineteen pesticide compounds tested in eight tissue samples were below laboratory instrument detection. Only two of the fifty-six semivolatile organic compounds tested were detected (phenol and 1,2,4-trichlorobenzene) in the fish tissue samples. Four metals (barium, lead, mercury and zinc) of the nine tested were detected in six of the whole body fish samples. The mercury concentration was below the FDA 1.0 ppm level of concern for edible portions.

East Fork Mill Creek

- Macroinvertebrate communities ranged from marginally good to fair in quality. The drop in quality occurred in sites downstream from the Butler County Upper Mill Creek WWTP. Fish communities were represented by a number of pollution intolerant species in the upper reaches

of East Fork Mill Creek (RM 4.7, 3.8, and 1.9); low numbers of pollution tolerant species were present. Degradation of the fish community was documented downstream from the Upper Mill Creek WWTP. The fish results from the sampling site 0.2 miles downstream from the Upper Mill Creek WWTP suggested a toxic impact probably due to the numerous ammonia violations from the WWTP. Some improvement or recovery in the population was evident near the mouth of East Fork Mill Creek.

West Fork Mill Creek

- The quality of macroinvertebrate communities in West Fork Mill Creek ranged from fair to poor. The lower performance rating occurred at river mile 2.0, downstream from an observed septic discharge and evident lime sludge from the water treatment plant of the Village of Wyoming. Trash and rubbish also was present at this site. Some improvement in the invertebrate community was observed at sites farther downstream. All sampling locations for fish communities documented populations indicative of poor water quality.

Sediment Toxicity

- Sediment samples from nine sites on the mainstem of Mill Creek were assessed for toxicity through USEPA using *Hyalella azteca*, an amphipod, in short-term bioassays. Data was statistically analyzed using two methods: 1) comparing the data as a whole to a control sample and 2) comparing each site individually to a control. The results of comparing the data as a whole to the control sample indicated that only one site, Gest St. (RM 0.5), exhibited toxicity. However, when the results from each sample were compared individually to the control sample eight of the nine sites exhibited toxicity.

Spills

- The spills reports from the Emergency Response Section of Ohio EPA for the period of 1988 through 1992 indicate significant numbers of spills occurring in the Mill Creek basin. Several entities have been documented as having repeated releases of a variety of substances ranging from raw sewage to toxic chemicals.

Conclusions

- The lower 17 miles of Mill Creek are plagued by impacts from old industrial and municipal landfills, hazardous waste sites, industry, combined sewer overflows, raw sewage discharges, leaking sewer lines and general urban runoff. Heavy suburban development pressures have increased the nonpoint source pollution problems in the upper reaches of the stream which were and still are to some extent already impacted by agricultural activities.
- Water chemistry impairments are mainly found in the lower 17 miles of Mill Creek and include elevated concentrations of some heavy metals, organic compounds, pesticides, ammonia, nutrients and bacteria from sewage contamination.
- Sediment analyses indicated elevated concentrations of heavy metals, PCBs, organic compounds and pesticides also in the lower 17 miles of Mill Creek.
- Pollution impacts have reduced the biological community to a predominance of pollution tolerant species. Toxic conditions in certain areas of Mill Creek have resulted in high percentages of external anomalies in the fish population. Fish tissue analyses identified concentrations of PCBs in some species in exceedance of maximum FDA recommended levels.

- In addition to the chemical pollution impacts, permanent stream channel modifications to the lower eight miles of Mill Creek have made it improbable that this portion of the stream can achieve the WWH use and therefore goals of the Clean Water Act. Upstream from this area, previous stream modification projects and removal of riparian vegetation have impacted the stream. However, some channel recovery was apparent during the 1992 survey, indicating the potential of the stream to recover to natural channel conditions.
- All tributaries sampled exhibited some type of pollution problem and many were impacted by stream channel modifications. Parameters indicative of sewage treatment plant discharges were documented in the main channel of Mill Creek downstream from East Fork Mill Creek and Town Run. Tributaries in the lower reaches exhibited contamination indicative of industrial activities and combined sewer overflows.