Missouri Department of Natural Resources

Biological Assessment of Gravel Mines

Beaver Creek
Taney County

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Prepared for:

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Water Protection and Soil Conservation Division
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Figure 1 Study area stations and location of potential gravel mining influence on Beaver Creek, Taney County

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Appendix A Missouri Department of Natural Resources Bioassessment Study Proposal, Beaver Creek, Taney County

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1.0 Introduction

At the request of the Missouri Department of Natural Resources (**MDNR**) Water Pollution Control Program (**WPCP**), the Environmental Services Program (**ESP**) Water Quality Monitoring Section (**WQMS**) conducted a macroinvertebrate bioassessment study of Beaver Creek in Taney County.

The Beaver Creek study area comprised approximately 10 stream miles in Taney County upstream from Bull Shoals Lake east of Taneyville, Missouri. This segment of Beaver Creek is considered in the 10 CSR 20-7 Rules of Department of Natural Resources, Clean Water Commission, Water Quality Standards as a class "P" stream. A class P stream maintains permanent flow even in drought periods. Use designations are "irrigation, livestock and wildlife watering, protection of warm water aquatic life and human health-fish consumption, cool water fishery, whole body contact recreation, and boating and canoeing."

1.1 Justification

Gravel mining is conducted at several sites on Beaver Creek. Gravel mining may be detrimental to macroinvertebrate and fish communities, mainly due to alteration of habitat. Fine sediment may significantly increase within the substrate at disturbed and downstream sites from gravel mines, affecting macroinvertebrates and fish assemblages (Brown and Lyttle 1992). Fines and silt clog the interstitial voids between the larger substrate particles and can have destructive effects on invertebrates and fish communities (Smale et al. 1995; Berkman and Rabeni 1987; Murphy et al. 1981; Chutter 1969).

It was our intention to determine if gravel mining was impairing Beaver Creek. A biological assessment and habitat assessment was conducted and scores were compared upstream to downstream of two gravel mines and with biological reference streams within the Ozark/White Ecological Drainage Unit (**EDU**).

In 2002, a study plan for a bioassessment study was submitted to the MDNR, WPCP (Appendix A). Some modifications to the study plan have been made. Fish sampling and percent sediment estimation had to be excluded. Also, two instead of three gravel mines were chosen for study. The WQMS was responsible for the proposed bioassessment study on Beaver Creek, Taney County.

1.2 Purpose

The purpose of the study was to determine if Beaver Creek was impaired by gravel mining.

1.3 Objectives

1) Determine if the macroinvertebrate community and water quality of Beaver Creek were affected by gravel mining.

2) Define habitat influences on Beaver Creek.

1.4 Tasks

1) Conduct a biological assessment of Beaver Creek, Taney County.

2) Conduct a habitat assessment on Beaver Creek.

1.5 Null Hypotheses

The macroinvertebrate communities are similar between the control (upstream) and test (downstream) stations on Beaver Creek.

The macroinvertebrate communities of the Beaver Creek stations and biological criteria reference streams for the Ozark/White EDU are similar.

Water quality is similar between control and test stations.

Habitat assessments are similar upstream and downstream from gravel mining facilities.

2.0 Methods

This project was conducted by the Water Quality Monitoring Section of the Missouri Department of Natural Resources, Air and Land Protection Division, Environmental Services Program. Steve Humphrey, Kenneth B. Lister, and the staff of the Water Quality Monitoring Section conducted the study.

2.1 Study Timing

Reconnaissance and station selection were conducted during winter and early spring, 2002. The first spring bioassessment was conducted March 18, 2002 at Stations #3 and #4. In addition, a kicknet sample was collected from a captured stream segment located between Stations #3 and #4. A rain event and subsequent high stream stage precluded complete spring sampling at Stations #1 and #2 until April 16, 2002. The habitat assessments were conducted in mid-summer. Fall bioassessments were conducted September 17-18, 2002.

2.2 Station Descriptions

A total of four stations were sampled on Beaver Creek; one upstream and one downstream from each of two gravel mines in order to bracket the gravel mines (Table 1, Figure 1). Stations throughout this project are listed from upstream to downstream (e.g. #4, #3, #2, and #1). Station #4 was relocated further upstream for the September bioassessment because of low gradient and cattle influence at the lower location.

Table 1
Station Number, Legal and Descriptive Information for Beaver Creek

Station Number	County	Location ¼, Section, Township, Range	Description
#4 (April 2002)	Taney	Sec. 20, T. 24 N., R. 18 W.	Upstream WMK Materials
#4 (September 2002)	Taney	Sec. 21, T. 24 N., R. 18 W.	Upstream WMK Materials and Beaver Creek Ranch
#3	Taney	Sec. 29, T. 24 N., R. 18 W.	Downstream WMK Materials
#2	Taney	Sec. 36, T. 24 N., R. 19 W.	Upstream Beaver Creek Aggregates
#1	Taney	Sec. 6, T. 23 N., R. 18 W.	Downstream Beaver Creek Aggregates

2.2.1 Ecological Drainage Unit

An EDU is a region in which biological communities and habitat conditions are expected to be similar. Table 2 compares the land cover percentages from the Ozark/White EDU and the 14-digit Hydrologic Units (**HU**), #11010003020005 (Stations #4 and #3) and #11010003020007 (Stations #2 and #1) which contain the Beaver Creek study reach. Also listed are the land cover percentages for the Bull Creek reference station (HU #11010003010006) used for habitat assessment comparisons to Beaver Creek. Percent land cover data were derived from Thematic Mapper (TM) satellite data collected between 1991 and 1993 and interpreted by the Missouri Resource Assessment Partnership (MoRAP). Beaver Creek appears to be similar in percent land cover and can be compared with biological reference streams of the EDU for habitat assessments and biological assessments.

Table 2
Percent Land Cover. Percentages Based on 14-Digit Hydrologic Unit Codes
for the Ozark/White EDU, Bull Creek, and Beaver Creek

Land Cover (%)	Urban	Crops	Grassland	Forest	Swamp/Marsh
Ozark/ White EDU	0.9	0.4	46.4	48.8	0
Bull Creek (BIOREF)	0.2	0	35.7	62.9	0
Beaver Creek #4 & #3 Taney County	0	0.1	38.6	58.3	0
Beaver Creek #2 & #1 Taney County	0	0	32.1	63.6	0

2.3 Habitat Assessment

A standardized assessment procedure was followed as described for Riffle/Pool Habitat in the Stream Habitat Assessment Project Procedure (**SHAPP**); MDNR 2000a. The habitat assessment was conducted in mid-summer 2002 and comparisons were made between scores from upstream to downstream of each gravel mining facility. Habitat scores for Beaver Creek stations were also compared to the Bull Creek reference station within the Ozark/White River EDU. The Bull Creek station habitat assessment was also conducted in mid-summer 2002.

An attempt was made to visually determine the fine sediment percent composition of Beaver Creek depositional areas upstream and downstream from gravel mines, as per the study plan (Appendix A). However, the fine sediment survey could not be conducted because Beaver Creek was too large to accurately visualize in-stream fine sediment. Depositional areas were too deep to adequately see the stream bottom and shallower sections had flow that was too fast (i.e. faster than 0.5 feet per second) and thus were not depositional of fine sediment (i.e. less than particle size ca. 2mm = coarse sand). Therefore, we relied on the habitat score of the SHAPP to provide a general characterization of stream substrate at each station.

2.4 Biological Assessment

Biological assessments consisted of macroinvertebrate community assessments and physicochemical water analyses. Complete bioassessments were conducted at four stations on Beaver Creek in two seasons (spring and fall).

2.4.1 Macroinvertebrate Collection and Analysis

A standardized macroinvertebrate sample collection and analysis procedure was followed as described in ESP's Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (**SMSBPP**); MDNR 2001a. Three standard habitats (e.g. flowing water over coarse substrates, depositional substrates in non-flowing water, and root-mat) were sampled at all locations. Macroinvertebrate data from Beaver Creek were compared using ESP's Biological Criteria for Perennial/Wadeable Streams (**Biological Criteria Reference, BIOREF**). Macroinvertebrate BIOREF data were from samples collected at three reference streams within the Ozark/White EDU. A total of nine spring samples and eight fall samples were used to calculate the numeric criteria.

An additional single macroinvertebrate sample was collected from Beaver Creek on March 18, 2002 next to Station #3, the WMK Materials mining site. During the Beaver Creek reconnaissance of January 24, 2002, we observed floodplain gravel mining by this facility on the east bank, near the edge of the stream. Between the January and March dates, the stream overtopped the east bank and approximately one-third of the stream was diverted or captured within the mined area. A standard SMSBPP macroinvertebrate sample from coarse substrate was collected from this "break-out" or captured segment. Non-flowing and root-mat habitats were not available for sampling within the captured segment.

Macroinvertebrate scores were analyzed using two methods. The first analysis was an upstream to downstream metric evaluation, per the SMSBPP, versus BIOREF score ranges. Four metrics were used in the SMSBPP evaluation: 1) Total Taxa (**TT**), 2) Ephemeroptera/Plecoptera/Trichoptera Taxa (**EPTT**), 3) Biotic Index (**BI**), and 4) Shannon Diversity Index (**SDI**). The second analysis of the biological data was an evaluation of the dominant macroinvertebrate families (**DMF**) using percent composition of predominant macroinvertebrate taxa and fine sediment tolerances of macroinvertebrate taxa present.

2.4.2 Physicochemical Water Collection and Analysis

Physicochemical water samples were collected according to MDNR, ESP, Standard Operating Procedures (**SOPs**) and Project Procedures (**PPs**) for sampling and analyzing physical and chemical samples. Samples were collected concurrently with the macroinvertebrate samples.

Physicochemical parameters measured in the field included pH, temperature (C^0), conductivity (uS/cm), dissolved oxygen, discharge, and turbidity. Samples returned to the ESP laboratory included ammonia-nitrogen, nitrate + nitrite-nitrogen, Total Kjeldahl Nitrogen (**TKN**), and total phosphorus. Samples were collected per MDNR-FSS-001 Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations.

All samples were kept on ice until they were delivered to the ESP laboratory. The WQMS measured turbidity in the WQMS Biology Laboratory. All other samples were delivered to the ESP Chemical Analysis Section (**CAS**) in Jefferson City, Missouri for analyses.

Physicochemical comparisons were made upstream and downstream of each gravel mining operation. Results were also compared with acceptable limits according to the Missouri Water Quality Standards (MDNR 2000b).

2.4.3 Discharge

Stream flow was provided by the USGS Beaver Creek gauging station at Bradleyville, which is located a few miles upstream from the study area. Discharge was reported as cubic feet per second (**cfs**).

2.5 Quality Control

Quality control was used as stated in the MDNR Standard Operating Procedures and Project Procedures.

3.0 Results and Analyses

Variables included in the results were found to have high values or interesting trends. Habitat assessments and biological assessments, which include a macroinvertebrate assessment and physicochemical water analyses, are part of this results section.

3.1 Habitat Assessment

Two comparisons were made to adequately assess the quality of Beaver Creek habitat. First, in order to determine the percentage of similarity, the Beaver Creek habitat scores were compared to the habitat score from the Bull Creek BIOREF station that was also assessed for habitat quality in summer 2002. According to the SHAPP, a study stream that scores greater than 75 percent of reference stream conditions is considered to have habitat that fully supports a similar biological community. Secondly, comparisons were made of the habitat scores from upstream to downstream of each gravel mine.

Habitat assessment scores of all but one Beaver Creek station were nearly equal to or greater than the Bull Creek BIOREF station (Table 3). The exception was Station #4 (bioassessment conducted in March 2002) which scored 99 and was only 71 percent of the Bull Creek BIOREF station. Because of cattle influence and low stream gradient, Station #4 was relocated upstream in September 2002. It scored 147, which was 106 percent of the BIOREF. This justified moving Station #4 upstream to a better location. With the exception of the low score at the original Station #4, all other Beaver Creek stations were considered fully capable of sustaining aquatic communities.

Habitat scores were, with the exception of the original Station #4, slightly lower below each gravel operation. For example, Station #3, downstream from WMK Materials, scored 137 compared to 147 upstream at Station #4. Similarly, Station #1, downstream from Beaver Creek Aggregates, scored 158 while upstream Station #2 scored 171.

Table 3
Habitat Assessment Scores (SHAPP) for Beaver Creek and
Biological Criteria Reference (BIOREF) Station, July/August 2002

Stations	Beaver Creek #4*	Beaver Creek #4**	Beaver Creek #3	Beaver Creek #2	Beaver Creek #1	Bull Creek (BIOREF)
Habitat Score	99	147	137	171	158	139
Percent of BIOREF	71	106	99	123	114	100

*Bioassessment conducted in March 2002
**Bioassessment conducted in September 2002

3.2 Biological Assessment

As outlined in the methods, macroinvertebrate data were evaluated by two methods. The first analysis was metric evaluation per the Semi-quantitative Macroinvertebrate Stream

Bioassessment Project Procedure (**SMSBPP**). The second analysis of the biological data was an evaluation of dominant macroinvertebrate family (**DMF**) composition.

3.2.1 Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP)

The SMSBPP metric evaluations using numeric biocriteria were calculated for each station using BIOREF streams of the Ozark/White EDU in the biocriteria reference database. A maximum score of five (5) is possible for each of the four metrics [i.e. Total Taxa (TT); EPT Taxa (EPTT); Biotic Index (BI); Shannon Diversity Index (SDI)]. On a scale of twenty (20), 16-20 is considered full biological sustainability, 10-14 is partial biological sustainability, and 4-8 is non-biological sustainability. These criteria were calculated separately for the March/April and September sampling seasons from Tables 4 and 5, respectively.

During the March/April 2002 sample season, all Beaver Creek stations were considered to have full sustainability according to the requirements of the SMSBPP total scores (Table 4). Metric scores were similar upstream and downstream of each facility. The total score was 18 at Stations #4, #3, and #2, and a score of 16 was recorded at Station #1. Station #1 had one less EPT taxon than the number needed for a score of 5 (i.e. 31 instead of 32) and thus scored slightly below 18.

Table 4
Metrics Scores and Sustainability for Beaver Creek and Biological Criteria Reference (BIOREF) Stations (in gray), n=9 stations, March/April 2002

Beaver Creek	4	3	2	1	Score 5	Score 3	Score 1
Sample No.	0218021	0218022	0218035	0218036	--	--	--
Total Taxa	118	110	121	99	>96	96 - 48	<48
EPT Taxa	35	32	39	31	>31	31 - 16	<16
BI	4.92	5.47	5.39	5.46	<4.59	4.59-7.30	>7.30
SDI	3.79	3.48	3.76	3.56	>3.21	3.21-1.60	<1.60
Total Score	18	18	18	16	20 – 16	14 - 10	8 - 4
Sustainability	Full	Full	Full	Full	Full	Partial	No

In September 2002, Stations #4, #3, and #2 were again considered to have full sustainability according to the requirements of the SMSBPP (Table 5). However, Station #1 had only partial sustainability and scored 12. The lower score at this station was due to slight decreases in total taxa and SDI at this station. The addition of one taxon and 0.04 SDI value would have given Station #1 a total score of 18 and full sustainability.

Table 5
Metrics Scores and Sustainability for Beaver Creek and Biological Criteria Reference (BIOREF) Stations (in gray), n=8 stations, September 2002

Beaver Creek	4	3	2	1	Score 5	Score 3	Score 1
Sample No.	0218124	0218123	0218122	0218121	--	--	--
Total Taxa	94	88	88	78	>78	78 - 39	<39
EPT Taxa	29	28	25	22	>26	26 – 13	<13
BI	5.49	5.53	6.14	5.49	<4.70	4.70-7.35	>7.35
SDI	3.48	2.80	3.35	3.12	>3.15	3.15-1.57	<1.57
Total Score	18	16	16	12	20 – 16	14 - 10	8 - 4
Sustainability	Full	Full	Full	Partial	Full	Partial	No

3.2.2 Dominant Macroinvertebrate Families

The number of macroinvertebrate total taxa, EPT taxa, and percent EPT for March/April and September 2002 Beaver Creek stations are presented in Tables 6 and 7, respectively. These tables also provide, in bold type, the percent composition for the five dominant macroinvertebrate families (**DMF**) at each station. For comparison among stations, percentages in plain type represent macroinvertebrate families that were dominant at either of the three other Beaver Creek stations during the same sampling period or taxa of particular interest.

March/April macroinvertebrate samples from Beaver Creek contained a high number of total taxa and EPT taxa at most stations (Table 6). Station #4, upstream from WMK Materials, had a total taxa richness of 118 and 35 EPT taxa. The sample from Station #3, downstream from this facility, comprised 110 total taxa and 32 EPT taxa. Similarly, samples from Station #2, upstream from Beaver Creek Aggregates, contained 121 total taxa and 39 EPT taxa, while Station #1, downstream from this gravel operation, had 99 total taxa and 31 EPT taxa.

Chironomidae was the dominant family in all spring 2002 macroinvertebrate samples and constituted 37 percent of the organisms at Station #4. At this station, four families of mayflies comprised the remaining four dominant families and collectively made up 27 percent of the benthos. The four dominant mayfly families were rather evenly distributed among Heptageniidae (eight percent), Caenidae and Ephemerellidae (each seven percent), and Siphlonuridae (five percent). Another mayfly family, Isonychiidae, made up four percent of Station #4 organisms.

At Station #3, downstream from WMK Materials, Chironomidae made up 51 percent of the organisms. Only one mayfly family (Caenidae) was dominant and comprised 10 percent of the multi-habitat sample. Elmid beetles, tubificid worms, and pleurocerid snails were the next three dominant families at this station. In contrast to Station #4, Heptageniidae, Ephemerellidae, Siphlonuridae, and Isonychiidae collectively made up less than six percent of the organisms at Station #3.

Station #2, upstream from Beaver Creek Aggregates, dominant families were Chironomidae, Caenidae, Heptageniidae, Elmidae, and Isonychiidae. The three mayfly families made up 34 percent of the abundance at this station (Table 6).

Mayflies comprised only two of the dominant families at Station #1, below Beaver Creek Aggregates. Caenidae accounted for 17 percent of the organisms and Heptageniidae made up four percent of the sample. Chironomidae, elmid beetles, and black flies (Simuliidae) were the remaining dominant macroinvertebrate families at this station.

September 2002 Beaver Creek samples comprised from 78 to 94 total taxa (Table 7). EPT taxa were well represented at each station and decreased upstream to downstream from 29 at Station #4 to 22 at Station #1. Fall samples typically contain fewer taxa than spring samples, mainly due to spring emergence of aquatic insects and the lag time of development until larvae either grow to sufficient size or are located within the microhabitat that is sampled. Although fall samples contained fewer EPT taxa than spring samples, three of the four stations had a greater percent of Ephemeroptera than was found in the spring. This was largely because the abundance of Chironomidae in fall samples was substantially less than in the spring.

Upstream from WMK Materials at Station #4, the dominant macroinvertebrate families were Chironomidae (19 percent) followed by the mayfly families Tricorythidae (16 percent) and Heptageniidae (10 percent). The remaining dominant organisms at this station were elmid beetles, water mites (Arachnoidea), and caenid mayflies. Each of these taxonomic groups comprised nine percent of the Station #4 samples.

Station #3, downstream from this facility was dominated be Tricorythidae, which made up 38 percent of the sample. Chironomidae (12 percent) and Elmidae (10 percent) were the next most abundant families, followed by Arachnoidea and Pleuroceridae, each comprising five percent of the organisms. At Station #3, in contrast to Station #4, Heptageniidae and Caenidae were not dominant families and each made up four percent of the sample.

Station #2, upstream from Beaver Creek Aggregates, dominant macroinvertebrate families were Chironomidae (21 percent) followed by Elmidae (14 percent), Caenidae (12 percent), Arachnoidea (10 percent), and Tricorythidae (nine percent). Heptageniidae, although not one of the five dominant families, made up eight percent of the sample at this station.

Tricorythidae was the dominant family at Station #1, downstream from Beaver Creek Aggregates. These mayflies constituted 27 percent of the sample. Next in dominance were Chironomidae (15 percent), Elmidae (12 percent), and Pleuroceridae (six percent). Heptageniidae, Caenidae, and Arachnoidea each comprised five percent of the Station #1 sample.

Table 6
Beaver Creek Macroinvertebrate Composition and Dominant Macroinvertebrate Families (DMF) per Station, March/April 2002

Variable-Station	4	3	2	1
Sample Number	02-18021	02-18022	02-18035	02-18036
Total Taxa	118	110	121	99
Number EPT Taxa	35	32	39	31
% Ephemeroptera	37	22	44	33
% Plecoptera	5	4	3	3
% Trichoptera	1	1	2	2
% Dominant Macroinvertebrate Families (DMF; below)				
Chironomidae	**37**	**51**	**25**	**37**
Heptageniidae	**8**	2	**12**	**4**
Caenidae	**7**	**10**	**17**	**17**
Ephemerellidae	**7**	2	2	3
Siphlonuridae	**5**	1	<1	<1
Elmidae	4	**6**	**10**	**7**
Tubificidae	1	**5**	<1	<1
Pleuroceridae	2	**3**	<1	1
Simuliidae	1	1	<1	**4**
Isonychiidae	4	<1	**5**	2

Table 7
Beaver Creek Macroinvertebrate Composition and Dominant Macroinvertebrate Families (DMF) per Station, September 2002

Variable-Station	4	3	2	1
Sample Number	02-18124	02-18123	02-18122	02-18121
Total Taxa	94	88	88	78
Number EPT Taxa	29	28	25	22
% Ephemeroptera	44	52	34	46
% Plecoptera	0	0	0	0
% Trichoptera	6	2	4	3
% Dominant Macroinvertebrate Families (DMF; below)				
Chironomidae	**19**	**12**	**21**	**15**
Tricorythidae	**16**	**38**	**9**	**27**
Heptageniidae	**10**	4	8	**5**
Elmidae	**9**	**10**	**14**	**12**
Arachnoidea	**9**	**5**	**10**	**5**
Caenidae	**9**	4	**12**	**5**
Pleuroceridae	1	**5**	<1	**6**

3.2.3 Captured Stream Segment Sample

Table 8 and Appendix B provide macroinvertebrate data from the Beaver Creek captured stream segment **(CSS)** sample. For comparison, data are also listed from Station #4, Beaver Creek upstream from WMK Materials and Station #3, mainstem Beaver Creek below WMK Materials and adjacent to the CSS. All data are for the single habitat of coarse substrate.

The CSS sample had reduced total taxa richness, EPT taxa richness, and SDI values compared to Stations #4 and #3. Forty-four total taxa and 17 EPT taxa comprised the CSS sample compared to 73 total taxa and 29 EPT taxa found at Station #4 and 67 total taxa and 24 EPT taxa collected from Station #3. Diversity was also lower within the CSS sample and the biotic index of the CSS sample was similar to the Station #3 value.

Chironomidae were the dominant macroinvertebrate family (DMF) and made up 66 percent of the CSS sample, followed by five families of mayflies (Table 8). Chironomidae was also the DMF at Stations #4 and #3, but made up a much smaller percentage and comprised 32 percent and 20 percent, respectively, of the coarse substrate organisms. Mayflies constituted most of the remaining dominant families at Stations #4 and #3. The quick appearance and dominance (fewer than seven weeks of colonization time available within the captured stream segment) of Chironomidae and Ephemeroptera within the CSS sample was expected. This is because many chironomids and mayflies can quickly colonize disturbed habitats via drifting behavior from undisturbed areas upstream. Other organisms, such as elmid beetles, caddisflies, pleurocerid snails, and water mites are usually not a major part of stream drift and thus were largely missing from the CSS sample. They were, however, usually common within coarse substrates at Stations #3 and #4 (Appendix B).

Table 8
Beaver Creek Coarse Substrate. Macroinvertebrate Composition and Dominant Macroinvertebrate Families (DMF) per Station, March 2002

Variable-Station	Capt. Stream Seg.	4	3
Sample Number	02-28677	02-18021	02-18022
Total Taxa	44	73	67
EPT Taxa	17	29	24
BI	4.69	4.21	4.80
SDI	2.58	3.24	2.88
% Dominant Macroinvertebrate Families (DMF; (below)			
Chironomidae	**64**	**32**	**20**
Isonychiidae	**9**	**8**	1
Heptageniidae	**8**	**12**	**4**
Ephemerellidae	**7**	**13**	**4**
Baetidae	**2**	4	2
Caenidae	**2**	**10**	**9**
Elmidae	<1	3	**6**

3.3 Physicochemical Water

Physicochemical analyses of surface water grab samples are presented in Tables 9 and 10. There were two significant results. First, all values were typical of an unimpaired Ozark stream. There were no exceedences of the Missouri Water Quality Standards. Dissolved oxygen was near saturation levels and most nutrient values were near or below detection limits both sampling periods. Secondly, results were similar upstream and downstream of each gravel operation. This was not unexpected since both gravel mining facilities were located either in the flood plain or in the riparian zone; neither facility was operating in-stream. Also, Beaver Creek Aggregates (the downstream facility, between Stations #1 and #2) was not operating during the study period and any impacts would have been caused by earlier disturbances.

March/April results were notable for fairly high stream discharge. As provided by the USGS gauging station at Bradleyville, March values were 307 cubic feet per second (cfs) and April flow was 400 cfs (Table 9). Turbidity levels, however, remained very low and indicated no excessive inputs of suspended sediment during the sampling period. Nutrient concentrations were also low; the highest nitrate/nitrite nitrogen level was 0.63 mg/L at Stations #1 and #2. TKN values also increased at Station #1 and measured 0.66 mg/L. However, total phosphorus values were below the detection limits of 0.05 mg/L at all stations.

Table 9
Physicochemical Water Variables per Station, Beaver Creek, March/April 2002
Units mg/L unless otherwise noted.

Variable-Station	Beaver Creek #4, Upstream WMK Materials March 18, 2002	Beaver Creek #3, Downstream WMK Materials March 18, 2002	Beaver Creek #2, Upstream Beaver Creek Aggregates April 16, 2002	Beaver Creek #1, Downstream Beaver Creek Aggregates April 16, 2002
Phys/Chem Sample No.	0216450	0216451	0216476	0216477
pH (Units)	8.50	8.40	8.50	8.20
Temperature (C^0)	10	10	18	18
Conductivity (uS)	377	377	355	358
Dissolved O_2	11.80	12.10	10.00	10.60
Discharge (cfs)	307	307	400	400
Turbidity (NTUs)	<1.00	1.09	2.03	3.01
Ammonia-N	<0.05	<0.05	<0.05	<0.05
Nitrate + Nitrite-N	0.49	0.47	0.63	0.63
TKN	<0.20	<0.20	<0.20	0.66
Chloride	<5.00	5.14	5.02	5.12
Total Phosphorus	<0.05	<0.05	<0.05	<0.05

September physicochemical samples (Table 10) were collected during an extended period of dry weather. Discharge at the Bradleyville gauging station was only 11 cfs. All analyzed variables were at expected values or at low levels. Dissolved oxygen concentrations were close to saturation levels and turbidity levels were low. There was no algal bloom or excessive suspended sediment. Nearly all nutrient levels were below detection limits at all stations (Table 10).

Table 10
Physicochemical Water Variables per station, Beaver Creek, September 2002
Units mg/L unless otherwise noted.
Note: Beaver Creek #4 is farther upstream than April #4.

Variable-Station	Beaver Creek #4, Upstream WMK Materials & Beaver Creek Ranch (NEW) September 18, 2002	Beaver Creek #3, Downstream WMK Materials & Beaver Creek Ranch September 18, 2002	Beaver Creek #2, Upstream Beaver Creek Aggregates September 17, 2002	Beaver Creek #1, Downstream Beaver Creek Aggregates September 17, 2002
Phys/Chem Sample No.	0230853	0230852	0230851	0230850
pH (Units)	8.10	8.30	8.40	8.30
Temperature (C^0)	22	23	24	23
Conductivity (uS)	399	421	410	410
Dissolved O_2	8.50	7.92	9.44	8.17
Discharge (cfs)	11.0	11.0	11.0	11.0
Turbidity (NTUs)	1.63	2.80	1.96	1.36
Ammonia-N	<0.05	<0.05	<0.05	<0.05
Nitrate + Nitrite-N	0.05	<0.05	<0.05	<0.05
TKN	<0.20	<0.20	<0.20	0.23
Chloride	<5.00	<5.00	<5.00	5.36
Total Phosphorus	<0.05	<0.05	<0.05	<0.05

4.0 Discussion

This discussion is arranged under two main topics. Firstly, the results of habitat assessment, metric scores, and macroinvertebrate composition are discussed. Secondly, problems in assessing impacts of gravel mining on streams and their macroinvertebrate fauna are considered.

4.1 Habitat Assessment

The SHAPP of Beaver Creek found somewhat lower habitat scores below each gravel facility. The slightly lower habitat scores below each facility indicated that aquatic habitat had not been substantially impaired by gravel mining at the time of assessment in 2002. Three in-stream habitat parameters of the SHAPP illustrate the general uniformity of Beaver Creek macroinvertebrate habitat. These are (1) epifaunal substrate and in-stream cover, (2) embeddedness, and (3) overall observation of sediment deposition. These habitat parameters

were judged optimal or suboptimal at all Beaver Creek stations except upstream Station #4 during the spring, which had a moderate deposition of sediment and was rated marginal for this habitat parameter. Based on field observations by two personnel, there was no indication of obvious in-stream habitat degradation downstream of the gravel mines. However, an exception was the partial stream capture of Beaver Creek apparently caused by poor mining practices of WMK Materials. Although this event was an obvious severe habitat impact, the capture had not impaired the mainstem macroinvertebrate community of Beaver Creek.

4.2 Metric Scores

Gravel mining showed no impacts large enough to greatly alter total scores and sustainability. As reported in the results, full sustainability was attained at each station in the spring and three of four stations had full sustainability in the fall (Tables #4 and #5, respectively). However, there was a general trend of less diversity downstream. Individual metric scores exhibited upstream/downstream differences that indicated slight impairment. March/April samples had slightly lower total taxa, EPT taxa, higher BI scores, and lower SDI values downstream of each gravel mine. Similarly, September samples also contained fewer total taxa, EPT taxa, and lower SDI values downstream from each facility. It cannot be determined from this data if these upstream/downstream differences were due to chance or impairment, but an in-depth study may reveal the cause of differences.

4.3 Macroinvertebrate Composition and Relative Abundance of Dominant Families

The dominant macroinvertebrate family data (Tables #6 and #7) showed some substantial differences in upstream/downstream dominant family composition, especially in the spring. Generally, upstream stations had a larger proportion of several mayfly families, while the downstream stations had a greater relative abundance of Chironomidae. Heptageniidae, for example, made up eight percent and 12 percent of the organisms at Stations #4 and #2, respectively. At the downstream Station #3 these mayflies comprised only two percent of the sample and at downstream Station #1 they made up four percent of the benthos. Isonychiid mayflies were also several times more abundant at upstream stations in the spring. Heptageniidae (*Stenonema* sp.) and Isonychiidae are considered intolerant of deposited sediment (Zweig and Rabeni 2001). Caenidae, mostly *Caenis latipennis,* were a dominant family at all stations in the spring. Although Zweig and Rabeni (2001) list *C latipennis* as intolerant of deposited sediment, we have found this species often very abundant in silty depositional habitats.

Fall macroinvertebrate samples showed some differences in upstream/downstream proportions of dominant mayfly families. Tricorythid mayflies are often abundant in the fall when most individuals mature and emerge. Studies by MDNR have found *Tricorythodes* abundant in sandy substrates within riffle/runs. In this study, Tricorythidae was the most abundant macroinvertebrate family downstream of each gravel facility in the fall. They were over two times more abundant at Station #3 than Station #4, and these organisms were three times more common at Station #1 than at Station #2. As in the spring, heptageniid mayflies were more common at upstream than downstream stations. This suggests a greater quantity of fine sediments downstream from the gravel mines.

The distribution of mayflies may be related to effects of gravel mining or may be due to chance or some other factor. This study was designed as a baseline semi-quantitative effort. In addition, measurements of percent coverage of the substrate by fine sediment could not be carried out and thus, macroinvertebrate taxa could not be correlated with sediment measurements. Therefore, the cause of upstream/downstream differences in relative abundance of these taxa is unknown.

4.4 Problems in Assessing Macroinvertebrate Impairment from Gravel Mining

There were several aspects of this study that made assessment of gravel mining impacts difficult to accomplish on Beaver Creek. One factor is the rapid recolonization of disturbed habitats by benthic macroinvertebrates. Many macroinvertebrate groups such as mayflies, stoneflies, caddisflies, and chironomids will rapidly colonize a disturbed stream bed by drifting into the area from upstream. For example, in a study of northwestern Arkansas streams, Brown and Lyttle (1992) found that deliberately disturbed riffle/run stream sections of Clear Creek of the Illinois River were quickly recolonized. In one experiment to simulate in-stream disturbance by gravel mining, three entire stream riffles of approximately 100 square meters were completely disturbed using a front end loader to repeatedly scoop up and drop gravel substrate back into the stream. The authors found that nearly all taxa present before disturbance had recolonized the disturbed areas within one week. The authors speculated that the very quick recolonization occurred because the stream had a history of previous disturbances and that the colonizers were primarily fugitive species that were good colonizers but not good competitors.

A comparison of the taxa richness of the riffle fauna from the captured Beaver Creek stream segment (CSS) with the mainstem riffle benthos illustrates the quickness of the colonization response. The CSS sample contained roughly 60 to 70 percent of the number of total taxa and EPT taxa found at Stations #4 and #3 (Table 8). This colonization occurred in less than seven weeks in a completely new channel. If a mining disturbance is of short duration and the time period between mining events is long enough, one may expect nearly complete recolonization of certain macroinvertebrates within a stream segment.

Another factor that affected impact assessment of Beaver Creek was the type of gravel mining. Both facilities employed a method of gravel mining called floodplain pit mining (MDNR 2001b). A backhoe, trackhoe, or dragline is used to remove alluvium, which is then washed and sorted. Process water is usually returned to the stream after passing through settling basins to remove excess silt. Floodplain mining usually does not directly impact a stream as long as process water is properly treated, an adequate buffer between the stream and the mine is maintained, and mining depth does not extend below the water table. If recommended practices are not followed, such as mining too close to the stream edge or below the water table, the pit may capture the stream during flood events and may cause large pools or a braided channel to develop. Both conditions can have severe impacts on stream morphology and physicochemical parameters.

During this study, the WMK Materials gravel operation mined next to the stream at two locations. At the upper site the mine captured roughly one-third of Beaver Creek during a high water event and resulted in a dual channel during elevated stream stages. Although a significant portion of Beaver Creek was diverted from the main channel, this did not appear to have an

obvious impact upon the macroinvertebrates within mainstem Beaver Creek during the study. At the lower site, gravel mining was also conducted near the stream bank and potential stream capture was possible but this did not occur during the study.

A third factor that affected impact assessment was the timing and duration of the gravel mining. The Beaver Creek Aggregates facility was not operating during the study period and most potential impacts would have occurred prior to sampling. Meanwhile, stream recovery would have been occurring and may have diminished any impacts. In fact, most gravel mining in the Ozarks is conducted on an "as needed" basis by landowners and county governments. Many of the private gravel mines also operate on a seasonal basis. Mining may be conducted for several weeks or months to create a large quantity of mined material and then mining ceases for some period until additional sand and gravel is needed. During this down time, stream recovery likely occurs and mitigates impacts upon benthic macroinvertebrates.

5.0 Conclusions

The purpose of the study was to determine if Beaver Creek was impaired by gravel mining. Below are the conclusions regarding our findings of Beaver Creek habitat assessment, biological assessment, and water quality.

The null hypotheses were generally supported. Macroinvertebrate communities were similar between control and test stations on Beaver Creek and between Beaver Creek and biological criteria reference streams. Water quality and habitat assessments were similar upstream and downstream from the gravel mines.

Overall, the macroinvertebrate habitats were not obviously impaired below the gravel mines. However, the stream habitat was impaired or altered in two related instances. Part of the stream was captured at a WMK Materials mining site. Secondly, at the end of a channel, WMK Materials dug a mining pit too close to the stream and below the water table. This pit also set up a likely stream capture at that point. Both illustrate that poor mining practices may impair aquatic habitat.

We found slight impairment of the macroinvertebrate community downstream of the gravel mines. The Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP) indicated full sustainability at all but one Beaver Creek station each sampling period. Most individual metrics, however, indicated slight impairment downstream of each gravel mine. An analysis of the composition and relative abundance of dominant macroinvertebrate families found differences that also indicated some impairment downstream from each facility. Additional in-depth study would be needed to confirm this finding.

There was no impairment of Beaver Creek water quality at the time of the study.

6.0 Literature Cited

Berkman, H.E. and C.F. Rabeni. 1987. Effects of siltation on stream fish communities. Environmental Biology of Fishes 18:285-294.

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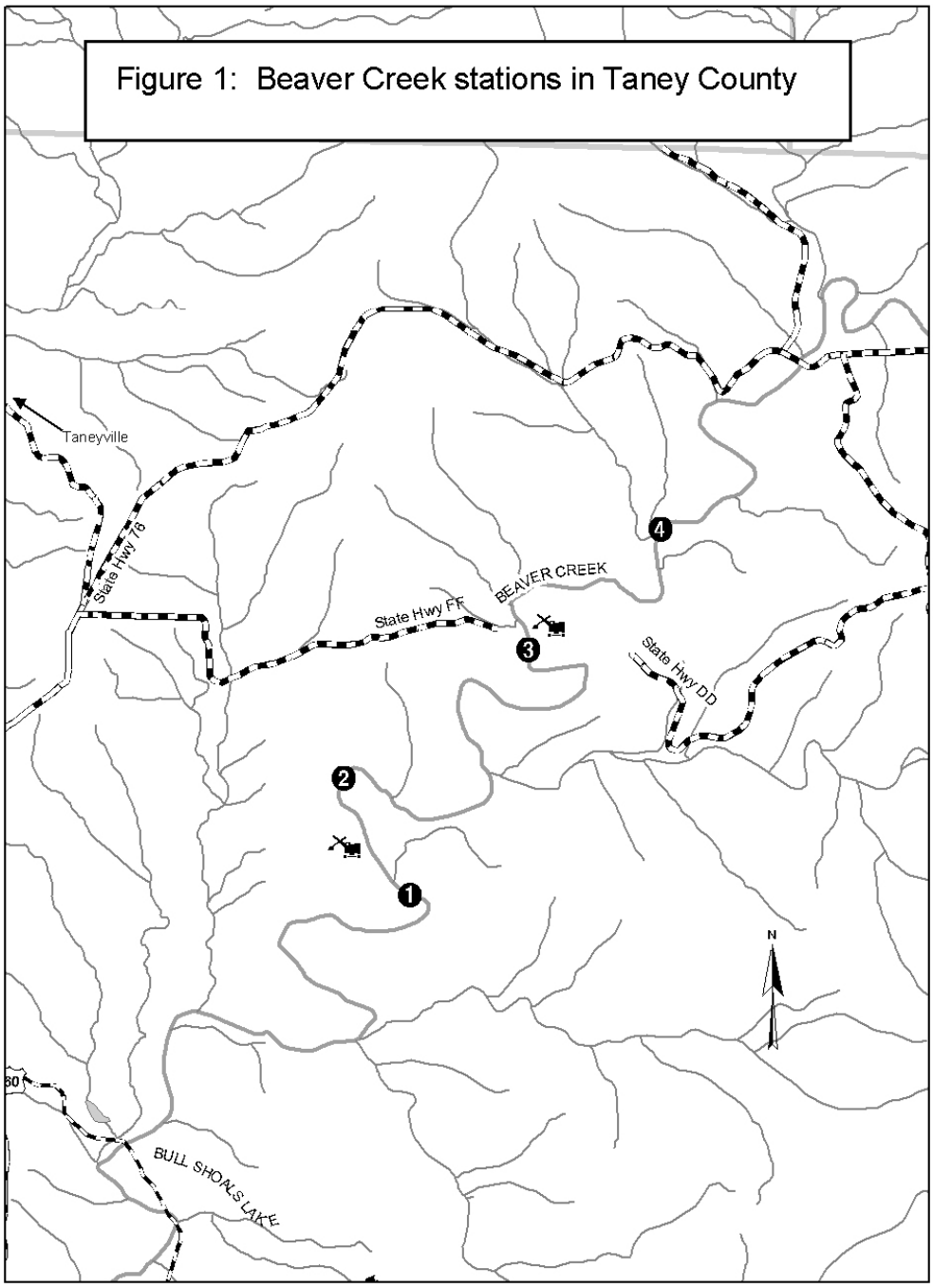

Figure 1: Beaver Creek stations in Taney County

Appendix A

Missouri Department of Natural Resources
Bioassessment Study Proposal
Beaver Creek
Taney County

Missouri Department of Natural Resources
Bioassessment and Sediment Study Plan
Beaver Creek
Taney County

Objective

Determine if aquatic communities are impaired in Beaver Creek, Taney County due to gravel mining.

Tasks

1) Conduct a bioassessment, including macroinvertebrates and fish, of Beaver Creek.

2) Conduct a habitat assessment of Beaver Creek.

3) Conduct a fine sediment assessment of Beaver Creek.

Null Hypotheses

Macroinvertebrate communities are similar between control and test stations on Beaver Creek, Taney County.

Fish assemblages are similar between control and test stations.

Habitat assessments will be similar upstream and downstream from gravel mining facilities.

Water quality is similar between control and test stations.

No significant difference ($p > 0.05$) in the fine sediment percentage between control and test stations.

Background

Beaver Creek, in Taney County, has several gravel mines. Gravel mining has been shown to be detrimental to both macroinvertebrate and fish assemblages, mainly due to alteration of habitat. Sedimentation of fine particle sizes may significantly increase at disturbed and downstream sites from gravel mines, affecting macroinvertebrate and fish communities (Brown et al. 1992). Fines and silt clog the interstitial voids between the larger particles and can have destructive effects on invertebrates and fish communities (Smale et al. 1995; Berkman and Rabeni 1987; Murphy et al. 1981; Chutter 1969). Using bioassessment, habitat assessment, and sediment assessment procedures, we intend to determine if gravel mining is a concern for aquatic life in Beaver Creek.

Study Methods

General: The upstream boundary is approximately 4.0 miles south of the Christian/Douglas/Taney county-lines, while the downstream boundary is approximately 4.0 miles upstream of Bull Shoals Lake southeast of Taneyville, Missouri. Three study areas were selected, each approximately 2.0 miles long and encompassing a single gravel mine.

A total of four stations will be sampled on Beaver Creek. Each study area will require two stations; one upstream and one downstream from each gravel mine. This will effectively bracket each of the three gravel mines.

Each station consists of a length of twenty-times the stream's average width, with at least two riffle reaches, as outlined in the MDNR Stream Habitat Assessment Project Procedure (SHAPP). One station (Station #4) will be upstream from all known gravel-mining influences (i.e. Control Station). The three remaining stations (Stations #1, #2, and #3, i.e. Test Stations) will be below each gravel mine (Figure 1). Sampling will occur in the spring and fall of 2002.

Bioassessment: Macroinvertebrates will be sampled according to the MDNR Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP). Beaver Creek, Taney County is considered a "Riffle/Pool" predominant stream and habitats will be sampled accordingly. Habitats included in these streams are coarse substrate, non-flow, and root-mat.

Fish will be sampled by the Missouri Department of Conservation during summer 2002. Species composition and abundance will be recorded and compared between reference and test stations.

Habitat Sampling: Stream flow and discharge will be measured using a Marsh-McBirney flow meter at the upstream and downstream extents of the study area. Stream habitat assessments will also be conducted within the study area in accordance with MDNR-FSS-032. Width and depth will be compared between reference and test stations.

Water Quality Sampling: Water quality samples will be collected at each sampling station during the spring and fall seasons. Parameters will include Total Kjeldahl Nitrogen (TKN), ammonia-nitrogen, nitrite plus nitrate nitrogen, total phosphorus, and chloride. The nutrient samples will be preserved with sulfuric acid. All samples will be kept on ice until they are delivered to the MDNR, Air and Land Protection Division (ALPD), Environmental Services Program (ESP), Chemical and Analytical Section (CAS) in Jefferson City, Missouri. In addition, four (4) 20-ml samples will be collected to measure turbidity. The biology/toxicity laboratory at MDNR-ESP will conduct these analyses.

Dissolved oxygen, pH, conductivity, and temperature will be measured once at all four stations on Beaver Creek.

Sediment Percentage and Characterization: To ensure sampling method uniformity, depositional areas sampled will be in-stream at the upper margins of pools and lower margins of riffle/run habitat. Depths of the sample areas will not exceed two (2.0) feet and water velocity will be less than 0.5 feet per second (fps). A Marsh McBirney flow meter will be used to ensure that water velocity of the sample area is within this range.

In-stream deposits of fine sediment (i.e. less than particle size ca. 2mm=coarse sand) will be estimated for percent coverage.

A visual method will be used to estimate the percentage of fine sediment. Each sampling station shall be composed of three sample areas (i.e. grids) each consisting of six contiguous transects across the stream. A tape measure will be stretched from bank to bank at each transect. One sample quadrat (ca. 10 x 10 inches) will be placed directly on the substrate within each of the six transects using a random number that equates to one foot increments. The trailing edge of the quadrat will be placed on the random foot increment. Two investigators will estimate the percentage of the stream bottom covered by fine sediment within each quadrat. If the estimated percentages are within ten percent between investigators it will be accepted. If estimates diverge more than ten percent, the investigators will repeat the process until the estimates are within the acceptable margin of error. An average of these two estimates will be recorded and used for analysis.

Laboratory Methods: Analyses of biological and chemical samples will be conducted at the MDNR Environmental Services Program (ESP) laboratory in Jefferson City, Missouri. Biological samples will be processed and identified according to MDNR-FSS-209 Taxonomic Levels for Macroinvertebrate Identifications.

Data Analysis: Macroinvertebrate data will be entered in a Microsoft Access database according to the MDNR Standard Operating Procedure MDNR-WQMS-214, Quality Control Procedures for Data Processing. Data analysis is automated within the Access database. Four standard metrics are calculated according to the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP): Total Taxa (TT); Ephemeroptera, Plecoptera, Trichoptera Taxa (EPTT); Biotic Index (BI); and the Shannon Index (SI) will be calculated for each station. Additional metrics such as Quantitative Similarity Index for Taxa (QSI-T) may be employed to discern differences in taxa between control and test stations. Macroinvertebrate data will be compared between reference and test stations on Beaver Creek. Macroinvertebrate data from reference streams within the Ozark/White EDU will allow for the calculation of a 25th percentile for the four metrics in the SMSBPP, and thus compared to Beaver Creek stations. Beaver Creek will be scored against these calculations and a composite score of 16 or greater will determine non-impairment.

The percentage of sediment deposition may be compared between stations, sites, or grids. This will be done by parametric comparisons of means, correlation, or non-parametric methods at a significant probability level ($p < 0.05$).

Ordination of communities with multiple linear regression may be used in conjunction with habitat assessment, water quality values, and sediment percentages, as well as character of sediments in order to correlate with environmental variables.

Data Reporting: A report will be written for the Water Pollution Control Program (WPCP) which outlines and interprets the results of the study.

Quality Controls: As stated in the various MDNR Project Procedures and Standard Operating Procedures.

Literature Cited:

Berkman, H.E., and C.F. Rabeni. 1987. Effects of siltation on stream fish communities. Environmental Biology of Fishes 18:285-294.

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Attachments: Figure 1: Study area control, test stations, and locations of gravel mines on Beaver Creek, Taney County.

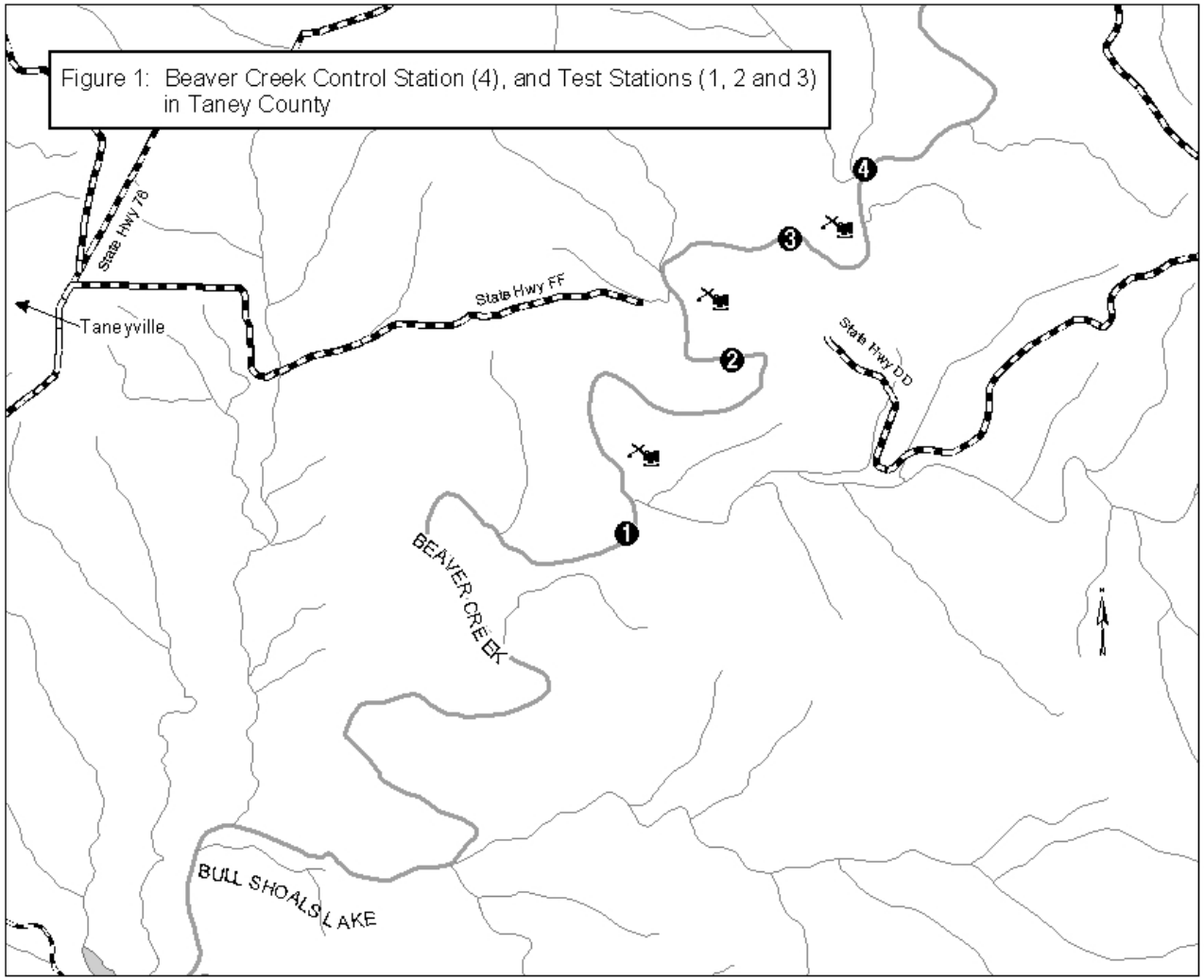

Figure 1: Beaver Creek Control Station (4), and Test Stations (1, 2 and 3) in Taney County

Appendix B

Macroinvertebrate Bench Sheets for Beaver Creek
March/April and October 2002

Key: CS=Coarse substrate habitat (i.e. riffle), NF=Non-Flow habitat (i.e. pools), RM=Root-mat habitat, *=Large/Rare presence

Aquatic Invertebrate Database Bench Sheet Report
March 18, 2002 - Beaver Ck [0218021], Station #4

ORDER (Taxa)	CS	RM	SG	NF
"HYDRACARINA"				
Acarina	5	36		6
AMPHIPODA				
Hyalella azteca	1	9		1
COLEOPTERA				
Uvarus		1		
Psephenus herricki				1
Ectopria nervosa				1
Scirtes		11		
Dubiraphia	11	7		19
Macronychus glabratus		2		
Microcylloepus pusillus	2			
Optioservus sandersoni	2			
Stenelmis	10			1
DIPTERA				
Tipula	-99			
Gonomyia	1			
Dasyheleinae				2
Ceratopogoninae		2		4
Simulium	8			
Prosimulium	7			
Ablabesmyia		5		15
Larsia		1		
Procladius				5
Cricotopus trifascia	2			
Paramerina		3		
Cricotopus bicinctus	1			
Corynoneura		1		1
Cricotopus/Orthocladius	62	17		26
Eukiefferiella	11			
Eukiefferiella brevicalcar grp	130			7
Orthocladius (Euorthocladius)	2			
Nanocladius	1			
Parakiefferiella				1
Parametriocnemus	2	1		1
Rheocricotopus	2			
Hydrobaenus		1		
Thienemanniella		1		
Synorthocladius	1			
Cryptochironomus				6
Dicrotendipes		1		3
Paracladopelma				4
Paralauterborniella				3
Paratendipes				2
Phaenopsectra		2		2
Polypedilum convictum grp	7			
Polypedilum illinoense grp		5		1
Polypedilum scalaenum grp				2
Pseudochironomus	1			2

ORDER (Taxa)	CS	RM	SG	NF
Cladotanytarsus	1			4
Paratanytarsus	1	10		2
Rheotanytarsus	3			1
Stempellinella	4	2		24
Tanytarsus	7	9		39
Dixella		1		
Dolichopodidae				1
Hemerodromia	1			1
Zavreliella	1			
Zavrelimyia				1
Monodiamesa				1
Potthastia	1	1		1
Thienemannimyia grp.	3	5		1
Labrundinia		29		3
EPHEMEROPTERA				
Siphlonurus		69		
Acentrella	28			
Diphetor	1			
Isonychia bicolor	58			
Heptageniidae	33			
Stenacron				6
Stenonema femoratum	3	1		17
Stenonema mediopunctatum	17			
Stenonema pulchellum	27	1		
Stenonema terminatum	7			
Ephemerella invaria	79			1
Ephemerella needhami	13			
Eurylophella		2		
Eurylophella bicolor	2			1
Serratella	1			
Tricorythodes	2			
Caenis anceps	26			2
Caenis latipennis	52	6		13
Caenis punctata		1		
Baetisca lacustris	1			
Paraleptophlebia	1	2		
Anthopotamus	6			7
Hexagenia limbata		2		1
HEMIPTERA				
Belostoma		1		
Ranatra fusca		1		
LEPIDOPTERA				
Petrophila	1			
LIMNOPHILA				
Fossaria		1		
Menetus	1	3		1
Ancylidae	1			
Laevapex		3		1
LUMBRICINA				
Lumbricidae	2			
LUMBRICULIDA				

ORDER (Taxa)	CS	RM	SG	NF
Lumbriculidae	2			
MESOGASTROPODA				
Elimia	12	5		2
Pleurocera	1	10		1
ODONATA				
Argia	5	1		3
Enallagma		2		2
Gomphus		-99		1
Hagenius brevistylus				1
Stylogomphus albistylus				-99
Epitheca (Tetragoneuria)		-99		
PLECOPTERA				
Amphinemura	17			
Prostoia	14			
Strophopteryx fasciata	4			
Perlesta	14			
Isoperla	13			
TRICHOPTERA				
Psychomyia	1			
Cheumatopsyche	2			
Ceratopsyche morosa grp	1			
Rhyacophila	-99			
Agapetus	5			
Hydroptila	2			1
Nectopsyche				1
TUBIFICIDA				
Tubificidae	4	1		11
Limnodrilus hoffmeisteri				6
Enchytraeidae				1
UNIONIDA				
Unionidae	-99			
VENEROIDEA				
Pisidium	1			
Sphaerium	1	1		4
Corbicula	2	1		

Aquatic Invertebrate Database Bench Sheet Report
September 18, 2002 - Beaver Ck [0228677], Station #SC

ORDER (Taxa)	CS	RM	SG	NF
"HYDRACARINA"				
Acarina	1			
COLEOPTERA				
Dubiraphia	1			
DIPTERA				
Tipula	1			
Ceratopogoninae	2			
Simulium	3			
Cricotopus bicinctus	4			
Corynoneura	2			
Cricotopus/Orthocladius	142			
Eukiefferiella	142			
Parametriocnemus	7			
Rheocricotopus	10			
Thienemanniella	1			
Cryptochironomus	1			
Polypedilum convictum grp	34			
Polypedilum illinoense grp	1			
Rheotanytarsus	1			
Stempellinella	2			
Tanytarsus	13			
Hemerodromia	1			
Clinocera	7			
Potthastia	6			
Sympotthastia	4			
Thienemannimyia grp.	6			
Cardiocladius	1			
EPHEMEROPTERA				
Acentrella	13			
Isonychia bicolor	54			
Stenacron	6			
Stenonema femoratum	8			
Stenonema mediopunctatum	23			
Stenonema pulchellum	9			
Ephemerella invaria	38			
Eurylophella bicolor	1			
Caenis latipennis	10			
Baetisca lacustris	3			
Leptophlebia	4			
Anthopotamus	1			
ODONATA				
Argia	1			
PLECOPTERA				
Prostoia	6			
Perlesta	1			
Isoperla	12			
TRICHOPTERA				
Wormaldia	1			
Agapetus	1			

ORDER (Taxa)	CS	RM	SG	NF
TUBIFICIDA				
Enchytraeidae	2			
VENEROIDEA				
Sphaerium	1			

Aquatic Invertebrate Database Bench Sheet Report
March 18, 2002 - Beaver Ck [0218022], Station #3

ORDER (Taxa)	CS	RM	SG	NF
Branchiobdellida	1	1		
"HYDRACARINA"				
Acarina	12			
AMPHIPODA				
Hyalella azteca	1	6		
ARHYNCHOBDELLIDA				
Erpobdellidae		1		
COLEOPTERA				
Hydrobius		4		
Psephenus herricki	1			
Helichus lithophilus	1			
Scirtes		1		
Ancyronyx variegatus				1
Dubiraphia	20	4		30
Macronychus glabratus	1			
Optioservus sandersoni	2			1
Stenelmis	12	1		5
DECAPODA				
Orconectes		2		
Orconectes ozarkae	-99			
DIPTERA				
Gonomyia	1			
Forcipomyiinae		1		
Ceratopogoninae				12
Simulium	16			
Prosimulium	1			
Ablabesmyia				6
Nilotanypus				1
Procladius				14
Cricotopus trifascia	4	1		
Cricotopus bicinctus	1	2		1
Corynoneura	1	6		1
Cricotopus/Orthocladius	55	43		12
Eukiefferiella	19			
Eukiefferiella brevicalcar grp	188	55		3
Orthocladius (Euorthocladius)	1	1		
Nanocladius	2	1		1
Parakiefferiella				1
Parametriocnemus	2	1		
Rheocricotopus	2			
Hydrobaenus		1		3
Thienemanniella		2		1
Synorthocladius	2			4
Chironomus				1
Cryptochironomus	1			3
Dicrotendipes	2			3
Cryptotendipes				3
Paralauterborniella				4

ORDER (Taxa)	CS	RM	SG	NF
Paratendipes				7
Phaenopsectra				2
Polypedilum halterale grp				3
Polypedilum convictum grp	4	6		
Polypedilum illinoense grp	2	2		
Polypedilum scalaenum grp				2
Stictochironomus				1
Pseudochironomus				2
Cladotanytarsus	1			2
Micropsectra				1
Paratanytarsus				1
Rheotanytarsus	3	5		
Stempellinella	1	2		21
Tanytarsus	8	3		10
Allognosta				1
Zavreliella				1
Potthastia				1
Sympotthastia	3	1		
Clinotanypus				1
Thienemannimyia grp.	3	4		4
Labrundinia		17		1
EPHEMEROPTERA				
Siphlonurus		16		1
Acentrella	13	4		
Isonychia bicolor	7	1		
Heptageniidae	6	1		
Stenonema femoratum		1		2
Stenonema mediopunctatum	6			1
Stenonema pulchellum	3			1
Stenonema terminatum	5	2		
Ephemerella invaria	14	4		
Ephemerella needhami	2	2		
Eurylophella	1	1		
Eurylophella bicolor	2	2		
Tricorythodes	12			
Caenis anceps	8	4		4
Caenis latipennis	41	25		38
Caenis punctata	1			
Baetisca lacustris				1
Leptophlebia		3		
Paraleptophlebia	1	5		
Anthopotamus	4			2
Ephemera				1
MEGALOPTERA				
Corydalus	-99			
Nigronia serricornis		-99		
MESOGASTROPODA				
Elimia	7	21		6
Pleurocera	2	1		1
ODONATA				
Argia	-99			

ORDER (Taxa)	CS	RM	SG	NF
Enallagma		1		
Basiaeschna janata		-99		
Hagenius brevistylus	-99	1		
PLECOPTERA				
Amphinemura	12	8		
Prostoia	2	6		
Strophopteryx fasciata	3			
Perlesta	3	4		
Clioperla clio		-99		
Isoperla	3			1
TRICHOPTERA				
Protoptila	1			
Hydroptila	2	1		
Oxyethira		1		
Helicopsyche	3			
Nectopsyche				1
TUBIFICIDA				
Tubificidae	1	1		50
Branchiura sowerbyi				1
Limnodrilus hoffmeisteri				11
Limnodrilus claparedianus				2
Enchytraeidae	1	2		2
VENEROIDEA				
Sphaerium	1			3
Corbicula	2			1

Aquatic Invertebrate Database Bench Sheet Report
April 16, 2002 - Beaver Ck [0218035], Station #2

ORDER (Taxa)	CS	RM	SG	NF
Branchiobdellida	1			
"HYDRACARINA"				
Acarina	4	4		41
AMPHIPODA				
Hyalella azteca	1	9		
COLEOPTERA				
Oreodytes				3
Hydroporus		1		
Hydrobius				1
Sperchopsis		4		
Psephenus herricki				1
Scirtes		6		
Ancyronyx variegatus		1		
Dubiraphia	2	9		26
Optioservus sandersoni	1			
Stenelmis	63			16
DIPTERA				
Tipula				-99
Gonomyia	3			
Psychoda				1
Forcipomyiinae				1
Ceratopogoninae	2			4
Ablabesmyia	3	4		16
Gymnometriocnemus				1
Nilotanypus	1	1		
Procladius		1		1
Corynoneura	2	4		
Cricotopus/Orthocladius	22	41		6
Eukiefferiella	4			1
Eukiefferiella brevicalcar grp	17			5
Nanocladius	1			
Parakiefferiella		1		
Parametriocnemus	4	1		
Rheocricotopus		2		
Hydrobaenus				1
Thienemanniella	1	5		
Synorthocladius		2		
Cryptochironomus	1			5
Dicrotendipes	1	2		1
Paralauterborniella				1
Lauterborniella		1		5
Paratendipes		2		3
Phaenopsectra				1
Polypedilum halterale grp				1
Polypedilum convictum grp	22	1		
Polypedilum fallax grp				1
Polypedilum illinoense grp		13		
Polypedilum scalaenum grp				3

ORDER (Taxa)	CS	RM	SG	NF
Stictochironomus				1
Tribelos				2
Pseudochironomus	1	1		1
Constempellina	2			5
Cladotanytarsus				4
Rheotanytarsus	1			
Stempellinella	3			2
Stempellina	2			3
Tanytarsus	12	3		7
Allognosta	1			2
Stratiomys		1		1
Chlorotabanus		1		
Hemerodromia	2			
Ephydridae	2			1
Zavrelimyia	1	1		
Thienemannimyia grp.	18	16		7
Labrundinia		1		
Diptera		1		3
EPHEMEROPTERA				
Siphlonurus		6		
Acentrella	1			
Baetis	1	1		
Centroptilum		16		
Isonychia bicolor	69			
Heptageniidae	7	2		1
Leucrocuta	41			5
Rhithrogena	1			
Stenacron	8			
Stenonema femoratum	24	2		5
Stenonema mediopunctatum	15			
Stenonema pulchellum	17	6		
Stenonema terminatum	9	2		
Ephemerella invaria	13			
Ephemerella needhami	1			
Eurylophella bicolor		6		
Eurylophella enoensis		5		
Tricorythodes	6	1		
Caenis anceps		9		25
Caenis latipennis	112	35		29
Leptophlebia				2
Paraleptophlebia	11	24		2
Anthopotamus	1			1
Ephemera				-99
Hexagenia				-99
ISOPODA				
Lirceus		1		
LEPIDOPTERA				
Petrophila	1			
LIMNOPHILA				
Fossaria		1		
Ferrissia		1		

ORDER (Taxa)	CS	RM	SG	NF
Laevapex	1			
LUMBRICINA				
Lumbricidae	1	1		1
MESOGASTROPODA				
Elimia	1	2		
Pleurocera	-99			
ODONATA				
Hetaerina		1		
Argia	13	2		2
Enallagma		11		
Hagenius brevistylus		1		
Stylogomphus albistylus	7			1
Libellulidae		1		-99
Epitheca (Epicordulia)				-99
PLECOPTERA				
Leuctridae	1			1
Amphinemura	4	5		
Perlesta	10	3		-99
Isoperla	9			
Pteronarcys pictetii	2			
TRICHOPTERA				
Wormaldia	2			
Glossosomatidae	2			
Hydroptila				1
Oxyethira				1
Pycnopsyche		-99		
Helicopsyche	4			1
Nectopsyche		3		
Triaenodes		2		
Oecetis		2		
TRICLADIDA				
Planariidae	1			
TUBIFICIDA				
Tubificidae	1	3		1
Branchiura sowerbyi	3	1		
Enchytraeidae	9	2		4
VENEROIDEA				
Corbicula	3			1

Quality Control Data	QCHabi	QCPicker

Aquatic Invertebrate Database Bench Sheet Report
April 16, 2002 - Beaver Ck [0218036], Station #1

ORDER (Taxa)	CS	RM	SG	NF
"HYDRACARINA"				
Acarina	1	5		
AMPHIPODA				
Hyalella azteca	1	2		
COLEOPTERA				
Dytiscidae	1			
Oreodytes		1		1
Paracymus				1
Psephenus herricki	3			
Ectopria nervosa	2			1
Helichus basalis	1			
Ancyronyx variegatus				1
Dubiraphia	5	1		5
Macronychus glabratus	1			
Optioservus sandersoni	2			
Stenelmis	40	1		2
Lutrochus	3			
DECAPODA				
Orconectes ozarkae	3			
DIPTERA				
Tipula	3			1
Gonomyia	6			
Ceratopogoninae	2	2		1
Simulium	30			
Prosimulium	4			
Ablabesmyia		7		13
Gymnometriocnemus		1		
Nilotanypus	1			
Procladius		1		
Cricotopus trifascia	3			
Corynoneura		2		1
Cricotopus/Orthocladius	62	6		3
Eukiefferiella	3	1		1
Eukiefferiella brevicalcar grp	80			3
Parametriocnemus	2			
Rheocricotopus		1		1
Thienemanniella	2	2		
Synorthocladius	1			
Endochironomus				2
Cryptochironomus				1
Dicrotendipes	1			
Paralauterborniella		2		
Microtendipes				1
Paratendipes				2
Polypedilum halterale grp				1
Polypedilum	1			
Polypedilum convictum grp	33			
Polypedilum illinoense grp				2
Polypedilum scalaenum grp	1			

ORDER (Taxa)	CS	RM	SG	NF
Pseudochironomus				1
Cladotanytarsus	1			
Micropsectra	1	1		
Rheotanytarsus	3	1		
Stempellinella		1		2
Tanytarsus	2	9		3
Odontomyia				1
Hemerodromia	4			1
undescribed Empididae	1			
Clinotanypus		1		1
Thienemannimyia grp.	7	2		3
Natarsia				2
Labrundinia		4		
EPHEMEROPTERA				
Siphlonurus		2		
Acentrella	4			
Baetis	1			
Centroptilum		8		
Isonychia bicolor	18			
Heptageniidae	3	1		
Leucrocuta	11			
Stenonema femoratum	9	1		
Stenonema mediopunctatum	4			
Stenonema pulchellum	2	1		
Stenonema terminatum	6			
Ephemerella invaria	11			
Ephemerella needhami	8			
Eurylophella bicolor	2	2		1
Serratella deficiens	1			
Tricorythodes	17			
Caenis latipennis	74	27		31
Baetisca lacustris	1			
Leptophlebia		1		
Paraleptophlebia	1	1		
Anthopotamus	3			1
ISOPODA				
Lirceus				1
LUMBRICINA				
Lumbricidae	5			
MEGALOPTERA				
Corydalus	2			
MESOGASTROPODA				
Elimia	6	5		
ODONATA				
Argia	1			
Enallagma		1		
PLECOPTERA				
Amphinemura	12			
Perlesta	10			
Isoperla	4			
Pteronarcys pictetii	1			

ORDER (Taxa)	CS	RM	SG	NF
TRICHOPTERA				
Wormaldia	2			
Polycentropus	1			
Cheumatopsyche	1			
Protoptila	3			
Hydroptila	2	1		
Triaenodes		2		
TUBIFICIDA				
Tubificidae		2		15
Branchiura sowerbyi				2
Limnodrilus cervix				1
Enchytraeidae	5			3
VENEROIDEA				
Sphaeriidae	1			2

Quality Control Data	QCHabi	QCPicker

Aquatic Invertebrate Database Bench Sheet Report
September 18, 2002 - Beaver Ck [0218124], Station #4

ORDER (Taxa)	CS	RM	SG	NF
Branchiobdellida		2		
"HYDRACARINA"				
Acarina	24	101		13
AMPHIPODA				
Hyalella azteca		3		
COLEOPTERA				
Berosus		2		
Psephenus herricki	2			1
Ectopria nervosa	1			2
Helichus lithophilus		1		
Ancyronyx variegatus		2		1
Dubiraphia	1	40		40
Macronychus glabratus		15		
Microcylloepus pusillus		1		
Optioservus sandersoni	6			
Stenelmis	21			15
DIPTERA				
Ceratopogoninae		1		1
Simulium	5			
Ablabesmyia	2	11		4
Procladius				5
Cricotopus bicinctus		1		
Cricotopus/Orthocladius	20	20		3
Nanocladius	2	2		
Parakiefferiella				1
Thienemanniella	1			
Cryptochironomus	1			7
Dicrotendipes	2	3		1
Cryptotendipes				2
Paralauterborniella				1
Phaenopsectra	2			1
Polypedilum halterale grp				1
Polypedilum				1
Polypedilum convictum grp	10			
Stenochironomus		2		
Polypedilum illinoense grp				1
Polypedilum scalaenum grp				2
Pseudochironomus	1			
Cladotanytarsus				21
Paratanytarsus		5		
Rheotanytarsus	54	3		1
Stempellinella		2		13
Stempellina				1
Tanytarsus	16	16		17
Tabanus	-99			1
Thienemannimyia grp.	6	2		
Labrundinia	1	8		2
Cardiocladius	10			

ORDER (Taxa)	CS	RM	SG	NF
EPHEMEROPTERA				
Acentrella	8			
Baetis	5			
Centroptilum	6	1		1
Procloeon	1			1
Isonychia bicolor	58			
Heptageniidae	42	3		
Stenacron	2			
Stenonema femoratum				13
Stenonema mediopunctatum	42			
Stenonema pulchellum	46	3		
Eurylophella	1			
Tricorythodes	238	3		1
Caenis anceps	49			51
Caenis latipennis		27		5
Baetiscidae	7			6
Leptophlebiidae				2
Choroterpes				1
Anthopotamus	1			13
Ephemera simulans	1			1
HEMIPTERA				
Rheumatobates		3		
Trepobates				1
LEPIDOPTERA				
Petrophila	2			
LIMNOPHILA				
Menetus		2		
Ancylidae		5		2
LUMBRICINA				
Lumbricidae	2			
MEGALOPTERA				
Corydalus	14			
MESOGASTROPODA				
Elimia	15	2		4
Pleurocera		-99		-99
ODONATA				
Hetaerina	1			
Argia	20	12		1
Enallagma		21		
Gomphidae	2	1		10
Hagenius brevistylus		-99		2
Ophiogomphus	1			-99
Libellulidae		5		1
Macromia		-99		
TRICHOPTERA				
Chimarra	1			
Ceratopsyche	1			
Cheumatopsyche	33			1
Hydropsyche	1			
Glossosoma	2			
Limnephilidae		-99		

ORDER (Taxa)	CS	RM	SG	NF
Helicopsyche	15			1
Nectopsyche		1		2
Triaenodes		19		
Oecetis	8	8		1
TRICLADIDA				
Planariidae	1			
TUBIFICIDA				
Tubificidae				4
Branchiura sowerbyi				1
VENEROIDEA				
Sphaeriidae				1

Quality Control Data	QCHabi	QCPicker

Aquatic Invertebrate Database Bench Sheet Report
September 18, 2002 - Beaver Ck [0218123], Station #3

ORDER (Taxa)	CS	RM	SG	NF
"HYDRACARINA"				
Acarina	48	8		29
AMPHIPODA				
Hyalella azteca		4		
COLEOPTERA				
Berosus		6		
Psephenus herricki	4			-99
Ectopria nervosa	1	2		-99
Helichus lithophilus		4		
Dubiraphia		70		52
Macronychus glabratus		8		
Optioservus sandersoni	7			
Stenelmis	16			14
DECAPODA				
Orconectes neglectus		-99		
DIPTERA				
Ceratopogoninae				2
Simulium	1			
Ablabesmyia		6		8
Nilotanypus	1			1
Cricotopus/Orthocladius	9	16		4
Nanocladius		1		1
Parakiefferiella				1
Thienemanniella	3			1
Cryptochironomus	1			3
Dicrotendipes	1	8		6
Paracladopelma				2
Polypedilum convictum grp	4	5		
Stenochironomus				1
Polypedilum illinoense grp		3		
Polypedilum scalaenum grp				5
Pseudochironomus		1		2
Cladotanytarsus				8
Paratanytarsus	3	6		1
Rheotanytarsus	19	5		2
Stempellinella				13
Tanytarsus	1	11		22
Hemerodromia		1		
Thienemannimyia grp.	1			2
Labrundinia		3		2
Cardiocladius	5			
EPHEMEROPTERA				
Acentrella				1
Baetis	2			
Procloeon		5		1
Isonychia bicolor	31			
Heptageniidae	8	3		11
Leucrocuta	1			
Stenonema femoratum				14

ORDER (Taxa)	CS	RM	SG	NF
Stenonema mediopunctatum	24			
Stenonema pulchellum				2
Ephemerella	1			
Tricorythodes	583	5		8
Caenis anceps	2			72
Caenis latipennis		1		
Baetiscidae				7
Choroterpes				2
Anthopotamus				19
Ephemera simulans				-99
LEPIDOPTERA				
Petrophila		2		
LIMNOPHILA				
Physella	1			
Menetus		1		
Ancylidae				8
LUMBRICINA				
Lumbricidae		-99		
MEGALOPTERA				
Sialis				1
Corydalus	2			
MESOGASTROPODA				
Elimia	28	46		8
Pleurocera		5		1
ODONATA				
Hetaerina		1		
Argia	3	16		4
Enallagma		23		
Boyeria		1		
Dromogomphus				6
Gomphus				1
Hagenius brevistylus		-99		1
Stylogomphus albistylus				-99
Macromia		3		-99
TRICHOPTERA				
Chimarra	1			
Psychomyia	1	1		1
Cheumatopsyche	3			
Protoptila	3			
Hydroptilidae				1
Hydroptila		1		
Oxyethira		2		
Helicopsyche	2			
Nectopsyche		1		7
Triaenodes		3		
Oecetis				1
TRICLADIDA				
Planariidae		2		
TUBIFICIDA				
Tubificidae				1
Branchiura sowerbyi	1			1

ORDER (Taxa)	CS	RM	SG	NF
Aulodrilus				3
VENEROIDEA				
Sphaeriidae				1
Corbicula	16	5		44

Aquatic Invertebrate Database Bench Sheet Report

September 17, 2002 - Beaver Ck [0218122], Station #2

ORDER (Taxa)	CS	RM	SG	NF
"HYDRACARINA"				
Acarina	15	106		1
AMPHIPODA				
Hyalella azteca		4		
COLEOPTERA				
Berosus		1		
Psephenus herricki	2			
Helichus lithophilus		2		
Scirtes	1			
Ancyronyx variegatus		2		
Dubiraphia		18		56
Stenelmis	57	2		45
Lutrochus	2			
DECAPODA				
Orconectes		-99		
DIPTERA				
Forcipomyiinae	1			
Simulium	1			1
Ablabesmyia	11			20
Nilotanypus	3			
Procladius		1		26
Cricotopus/Orthocladius	13	3		
Nanocladius				1
Parakiefferiella				3
Thienemanniella	4			
Chironomus				1
Cryptochironomus	3	1		5
Dicrotendipes	25			10
Cryptotendipes		1		2
Paralauterborniella				2
Paratendipes	1			
Parachironomus		1		
Polypedilum convictum grp	27			
Stenochironomus		3		
Polypedilum illinoense grp	4			
Polypedilum scalaenum grp				1
Stictochironomus				1
Cladotanytarsus	2			2
Paratanytarsus		3		
Rheotanytarsus	15			
Stempellinella	20			5
Tanytarsus	18	1		15
Dixella		2		
Thienemannimyia grp.	2			2
Labrundinia	2	5		
EPHEMEROPTERA				
Acentrella	8			1
Centroptilum				1
Procloeon		2		1

ORDER (Taxa)	CS	RM	SG	NF
Isonychia bicolor	18			1
Stenacron	6	1		3
Stenonema femoratum				9
Stenonema mediopunctatum	14			
Stenonema pulchellum	68			6
Tricorythodes	117			2
Brachycercus				1
Caenis anceps	55			94
Baetisca lacustris	1			
Leptophlebiidae	1			2
Choroterpes				2
Anthopotamus				2
Ephemera simulans	-99			1
HEMIPTERA				
Steinovelia		1		
Rheumatobates		6		
Trepobates		1		
Ranatra nigra		1		
LEPIDOPTERA				
Petrophila	2			
LIMNOPHILA				
Lymnaeidae		3		
Physella		2		
Menetus		36		
Ancylidae	1	3		
LUMBRICINA				
Lumbricidae	1			
MEGALOPTERA				
Sialis				-99
Corydalus	5			
MESOGASTROPODA				
Elimia	2			2
ODONATA				
Argia	13	34		3
Enallagma		29		
Basiaeschna janata		-99		
Gomphidae				7
Stylogomphus albistylus	1			
Macromia	1	1		1
Somatochlora		-99		
TRICHOPTERA				
Polycentropodidae		1		5
Cheumatopsyche	1			
Hydroptila	3			
Oxyethira	5			
Pycnopsyche		-99		
Helicopsyche	2			
Nectopsyche				1
Triaenodes		11		
Oecetis	15	5		1
TRICLADIDA				

ORDER (Taxa)	CS	RM	SG	NF
Planariidae	2	2		
TUBIFICIDA				
Tubificidae		2		1
VENEROIDEA				
Sphaerium	1			

Quality Control Data	QCHabi	QCPicker

Aquatic Invertebrate Database Bench Sheet Report

September 17, 2002 - Beaver Ck [0218121], Station #1

ORDER (Taxa)	CS	RM	SG	NF
"HYDRACARINA"				
Acarina	14	58		14
COLEOPTERA				
Psephenus herricki	2			
Ectopria nervosa				1
Helichus lithophilus	-99	5		
Scirtes		1		
Dubiraphia		52		46
Macronychus glabratus		15		
Microcylloepus pusillus		2		
Stenelmis	71			15
Lutrochus	3			
DECAPODA				
Orconectes		-99		
Orconectes longidigitus		-99		
Orconectes virilis	-99			
DIPTERA				
Simulium	9			
Ablabesmyia		1		5
Cricotopus trifascia	1			
Cricotopus bicinctus	1			
Cricotopus/Orthocladius	17	5		2
Nanocladius				6
Parakiefferiella				1
Thienemanniella	4			
Cryptochironomus				8
Dicrotendipes		1		11
Cryptotendipes				3
Paracladopelma				4
Paralauterborniella				3
Polypedilum convictum grp	21			2
Polypedilum illinoense grp	1	2		
Polypedilum scalaenum grp				1
Pseudochironomus				2
Cladotanytarsus				28
Paratanytarsus		4		5
Rheotanytarsus	20			2
Stempellinella				30
Tanytarsus	2	3		30
Hemerodromia				1
Thienemannimyia grp.	2			
Labrundinia	1	11		2
Cardiocladius	5			1
EPHEMEROPTERA				
Baetidae	5			
Acentrella	7			1
Baetis	2			
Centroptilum		2		8
Isonychia	72			

ORDER (Taxa)	CS	RM	SG	NF
Heptageniidae	26	4		
Stenonema femoratum				4
Stenonema mediopunctatum	17			4
Stenonema pulchellum	42			
Tricorythodes	447	3		9
Caenis anceps	11	11		70
Caenis latipennis	1			2
Baetiscidae				1
Choroterpes				3
Anthopotamus				5
LEPIDOPTERA				
Petrophila	-99			
LIMNOPHILA				
Physella				1
Menetus	1	10		9
Ancylidae	2	8		1
MEGALOPTERA				
Corydalus	12			
MESOGASTROPODA				
Elimia	90	18		2
Pleurocera		3		1
ODONATA				
Hetaerina	1			1
Argia	13	16		1
Enallagma		31		
Gomphidae		2		
Hagenius brevistylus				1
Macromia		-99		4
TRICHOPTERA				
Chimarra	2			
Cheumatopsyche	2			3
Oxyethira	2	3		
Helicopsyche	3			2
Nectopsyche		1		2
Triaenodes		14		
Oecetis	3	5		8
TRICLADIDA				
Planariidae		3		1
TUBIFICIDA				
Tubificidae		3		1
Branchiura sowerbyi				1
VENEROIDEA				
Sphaerium	25	4		18

Quality Control Data **QCHabi** **QCPicker**