Missouri Department of Natural Resources

Biological Assessment Report

Hinkson Creek
Boone County

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Prepared for:

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Water Protection and Soil Conservation Division
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1.0 Introduction

At the request of the Water Pollution Control Program (**WPCP**), the Environmental Services Program's (**ESP**) Water Quality Monitoring Section (**WQMS**) conducted a biological assessment of Hinkson Creek, which flows through the urban watershed of Columbia, Missouri. It was added to the 303(d) list of impaired waters in 1998 due to concerns of potential water quality degradation from stormwater runoff. Additionally, rapid development in Columbia potentially has had detrimental effects on the stream channel and riparian areas.

Bonne Femme Creek, a nearby drainage which flows through a rural, rather than an urban watershed, was used as a control site to compare with Hinkson Creek. This comparison was to determine whether a biological impairment exists in a system largely comprised of urban runoff. Additionally, biological criteria reference streams were compared to both Hinkson and Bonne Femme creeks. Sampling at Hinkson and Bonne Femme creeks was conducted on September 17-20, 2001 and on March 18-21, 2002 to provide data to the WPCP for use in evaluating and comparing the biological integrity of the two streams. Sam McCord, Dave Michaelson, and Brian Nodine of the Environmental Services Program, Air and Land Protection Division conducted the sampling.

On August 9, 2001 a study plan was submitted to the WPCP (Appendix A). Two null hypotheses were stated in this plan. The first was that macroinvertebrate assemblages would not differ between longitudinally separate reaches of Hinkson Creek, i.e. between the most urbanized portions of the creek relative to sections upstream of those areas. The second was that macroinvertebrate assemblages would not differ between Hinkson Creek and similar sized reaches of either Bonne Femme Creek or other regional reference streams.

2.0 Study Area

Hinkson Creek originates in northeastern Boone County, northeast of Hallsville and flows southwest through an upper watershed of rural pasture land and wooded areas (see Table 1). The lower three sample stations of the stream reach assessed are in a reach classified "P" with beneficial use designations of "livestock and wildlife watering" and "warm water aquatic life protection, human health/fish consumption." The upper five sample stations of Hinkson Creek fall in a reach of the stream designated class "C" with the same beneficial use designations listed above.

Bonne Femme Creek originates southeast of Columbia and flows southwest through a watershed dominated by forest land (see Table 1). The stream reach assessed is class "P" with beneficial use designations of "livestock and wildlife watering" and "warm water aquatic life protection, human health/fish consumption." This stream was chosen as a control in the study due to several factors: its close proximity to the study stream within the same Ecological Drainage Unit (**EDU**); a watershed of comparable size; and a relative lack of urbanization in the watershed.

Hinkson and Bonne Femme creeks are located within the Ozark/Moreau/Loutre (**O/M/L**) EDU. An EDU is a region in which biological communities and habitat conditions can be expected to be similar. Please see Appendix B for maps of the EDUs and the 14-digit Hydrologic Units (HU), #10300102120002 and #10300102130003, that contain the sampling reaches for Hinkson and Bonne Femme creeks, respectively. See Table 1 for a comparison of land use for the 14-digit HUs. In addition to Hinkson and Bonne Femme creeks, land use for other biological criteria reference streams within the O/M/L EDU have been included in Table 1 for comparison. Land cover data were derived from the Thematic Mapper satellite data from 1991-1993, and interpreted by the Missouri Resource Assessment Partnership (MoRAP).

Table 1
Percent Land Cover

	Urban	Crops	Grassland	Forest	Swamp
O/M/L* EDU	1.9	20.9	40.3	35.0	0.0
Hinkson Cr. HU	12.7	6.7	47.4	32.2	0.0
Bonne Femme Cr. HU	0.0	17.3	40.3	41.9	0.0
Loutre R. HU	1.3	29.9	24.8	42.6	0.0
Moniteau Cr. HU	0.0	29.5	54.1	15.9	0.0
Boeuf Cr. HU	0.7	19.2	45.7	33.6	0.0
Burris Fk. HU	0.5	12.7	68.0	18.0	0.0

*Ozark/Moreau/Loutre

3.0 Site Descriptions

All sampling locations were located within Boone County. The average width and discharge measurements during both survey periods are given for each sampling station in Table 2 in the results section.

Hinkson Creek Station #1 (SE ¼ sec. 29, T. 48 N., R. 13 W.) was located downstream of the Scott Boulevard bridge. Geographic coordinates at the upstream terminus of this station were Lat. 38.91405°, Long. –92.40037.

Hinkson Creek Station #2 (SE ¼ sec. 21, T. 48 N., R. 13 W.) was located downstream of the Missouri Department of Conservation (MDC) Twin Lakes Recreational Area. Geographic coordinates at the upstream terminus of this station were Lat. 38.92193°, Long. –92.37728.

Hinkson Creek Station #3 (NE ¼ sec. 27, T. 48 N., R. 13 W.) was located downstream of the Forum Boulevard bridge. Geographic coordinates at the upstream terminus of this station were Lat. 38.92139°, Long. –92.36465.

Hinkson Creek Station #4 (NW ¼ sec. 19, T. 48 N., R. 12 W.) was located downstream of the Rock Quarry Road bridge. Geographic coordinates at the upstream terminus of this station were Lat. 38.93143°, Long. –92.32450.

Hinkson Creek Station #5 (NW ¼ sec. 19, T. 48 N., R. 12 W.) was located upstream of the most upstream footbridge of Capen Park. Geographic coordinates at the upstream terminus of this station were Lat. 38.93256°, Long. –92.31755.

Hinkson Creek Station #6 (SW ¼ sec. 8, T. 48 N., R. 12 W.) was located downstream of the Walnut Street bridge. Geographic coordinates at the upstream terminus of this station were Lat. 38.95760°, Long. –92.29847.

Hinkson Creek Station #7 (NW ¼ sec. 27, T. 49 N., R. 12 W.) was located upstream of the Hinkson Creek Road/Wyatt Lane bridge. Geographic coordinates at the upstream terminus of this station were Lat. 39.00566°, Long. –92.25904.

Hinkson Creek Station #8 (SE ¼ sec. 15, T. 49 N., R. 12 W.) was located downstream of the Rogers Road bridge. Geographic coordinates at the upstream terminus of this station were Lat. 39.02321°, Long. –92.24647.

Bonne Femme Creek Station #1 (SE ¼ sec. 25, T. 47 N., R. 13 W.) was located downstream of the Nashville Church Road bridge. Geographic coordinates at the upstream terminus of this station were Lat. 38.82237°, Long. –92.32965.

Bonne Femme Creek Station #2 (SW ¼ sec. 30, T. 47 N., R. 12 W.) was located upstream of the Nashville Church Road bridge. Geographic coordinates at the upstream terminus of this station were Lat. 38.82385°, Long. –92.32568.

4.0 Methods

4.1 Macroinvertebrate Collection and Analysis

A standardized sample collection procedure was followed as described in the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (**SMSBPP**). Three standard habitats, flowing water over coarse substrate, depositional substrate in non-flowing water, and rootmat at the stream edge were sampled at all locations. At Hinkson Creek Station 5, however, rootmat habitat was too scarce to provide a sample.

A standardized sample analysis procedure was followed as described in the SMSBPP. The following four metrics were used: 1) total taxa (TT); 2) total number of taxa in the orders Ephemeroptera, Plecoptera and Trichoptera (EPTT); 3) biotic index (BI); and 4) Shannon diversity index (SDI).

Additionally, macroinvertebrate data were analyzed in three specific ways. First, longitudinal comparisons between Hinkson Creek reaches upstream and downstream of potential impairment sources (e.g., Columbia landfill, Grindstone Creek) were performed. Patterns were illustrated using XY line graphs with stream location (river mile) on the X-axis and biological characteristics on the Y-axis. Secondly, upper (Stations 6-8) and lower (Stations 1-3) Hinkson Creek stations were compared to Bonne Femme Creek stations. These data were summarized and presented in bar graphs comparing the means of the four standard metrics, as well as other biological parameters, between the three general areas. Finally, the data from both Hinkson and Bonne Femme creeks were compared to biological criteria from regional reference streams within the same EDU and the same watershed size classification. Biocriteria data collected from fall 2001 and previous survey years constituted the basis of the comparison.

4.2 Physicochemical Data Collection and Analysis

During each survey period, *in situ* water quality measurements were collected at all stations. These included temperature (°C), dissolved oxygen concentration (mg/L), conductivity (µS/cm), and pH. Additionally, water samples were collected and analyzed by ESP's Chemical Analysis Section for turbidity (NTU), chloride, total phosphorus, ammonia-N, nitrate/nitrite-N, and total Kjeldahl nitrogen (**TKN**).

Stream velocity was measured at each station during each survey period using a Marsh-McBirney Flo-Mate Model 2000. Discharge was calculated per the methods in the Standard Operating Procedure MDNR-FSS-113 (Flow Measurement in Open Channels).

Stream habitat characteristics for each sampling station were measured during the fall 2001 survey period using a standardized assessment analysis procedure as described for riffle/pool habitat in the Stream Habitat Assessment Project Procedure.

Physicochemical data were summarized and presented in tabular and graphic form for comparison among stations on Hinkson Creek, and between Hinkson Creek stations and those of Bonne Femme Creek and other regional reference streams.

4.3 Quality Assurance/Quality Control (QA/QC)

QA/QC procedures were followed as described in the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure.

5.0 Data Results

5.1 Physicochemical Data

Physical characteristics of each Hinkson Creek and Bonne Femme Creek station are presented in Table 2. Stream widths at Hinkson Creek stations ranged from 34 to 59 feet, but did not exhibit a clear longitudinal pattern (i.e., the creek did not increase in width from upstream to downstream stations). Stream flow did, however, generally increase from upstream to downstream stations. The only exception to this trend was noted in the spring 2002 survey. Flow at Station 8 was greater than those of Stations 7 and 6, which were downstream (see Figure 1). A moderate rain event occurred prior to sampling at these three locations. It is probable that the runoff from this rainfall had reached Station 8, but not Stations 7 and 6 at the time the flow measurements were taken. The difference between the readings at these three locations was small (approximately 1 cfs).

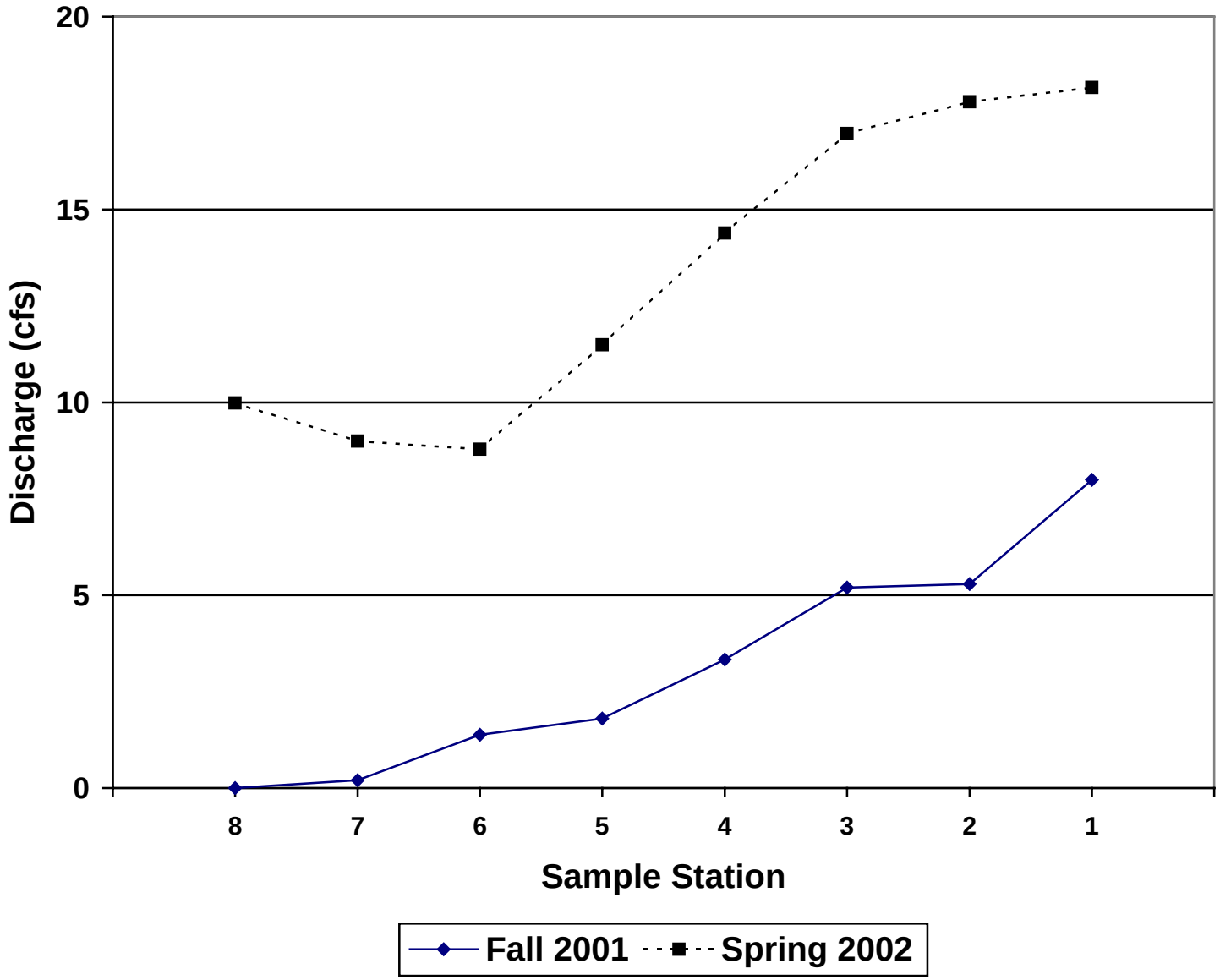
Table 2
Physical Characteristics of the Stations

			Fall 2001	Spring 2002
Creek	Station	Avg. Width (ft)	Flow (cfs)	Flow (cfs)
Hinkson	1	37	7.99	18.16
	2	59	5.29	17.79
	3	45	5.20	16.97
	4	57	3.33	14.39
	5	53	1.80	11.49
	6	40	1.38	8.78
	7	35	0.20	8.99
	8	34	0.00	9.98
Bonne Femme	1	39	0.65	2.60
	2	60	0.38	2.56

In situ water quality measurements are summarized in Tables 3 (Fall 2001) and 4 (Spring 2002). The principal type of variation in water temperature was seasonal. Mean temperatures at Hinkson Creek stations were 19.5°C and 9.3°C in the fall and spring surveys, respectively. At Bonne Femme Creek stations, mean temperatures were 17.5°C in fall 2001 and 7.6°C in spring 2002. There did not appear to be a longitudinal pattern in water temperature. Values were comparable at all sites and primarily differed as a result of the time of day at which they were taken. Water temperatures were similar between Hinkson Creek and Bonne Femme Creek stations.

Similarly, pH levels differed primarily on a seasonal basis, with pH being higher in the spring than in the fall. There were no consistent longitudinal trends among stations on Hinkson Creek. Moreover, no clear differences between Hinkson Creek and Bonne Femme Creek stations were evident for this parameter.

Figure 1: Hinkson Creek Discharge



With regard to conductivity, seasonal variation again was evident, with values from spring 2002 somewhat higher than those of fall 2001 at Hinkson Creek stations. At Bonne Femme Creek stations, conductivity levels were similar between seasons. In the fall survey period, levels were comparable between Hinkson Creek and Bonne Femme Creek sites. In contrast, conductivity levels at Hinkson Creek stations during spring 2002 were higher than those at Bonne Femme Creek stations. Longitudinal variation was primarily limited to a single occurrence on upper Hinkson Creek in the fall 2001 survey period. Station 7, located just downstream of the City of Columbia Sanitary Landfill, had a markedly greater conductivity value (786 µmhos/cm) than Station 8 (389 µmhos/cm) which was immediately upstream of the landfill. At Station 6, which was approximately 5 miles downstream of Station 7, the conductivity had decreased to 358 µmhos/cm.

Turbidity levels were consistently higher at Hinkson Creek stations than at Bonne Femme Creek stations. In the fall 2001 survey, turbidity generally increased from upstream sites to downstream sites on Hinkson Creek. In the spring 2002 survey, however, turbidity levels were greatest at the most upstream stations on Hinkson Creek. Although trends in turbidity levels were observed, the magnitude of difference even among the extremes was minor.

Table 3
In situ Water Quality Measurements at all Stations (Fall 2001)

Creek/Station	Parameter				
	Temp.	Diss. O_2	Cond.	pH	Turb.
Hinkson #1	20.7	7.1	442	7.4	12.1
Hinkson #2	19.8	7.0	428	7.3	16.8
Hinkson #3	21.9	7.1	421	7.4	14.3
Hinkson #4	20.2	9.2	488	7.6	7.2
Hinkson #5	20.6	8.2	408	7.4	12.1
Hinkson #6	18.8	7.5	358	7.5	8.0
Hinkson #7	17.2	6.8	786	7.3	8.4
Hinkson #8	16.7	5.8	389	7.8	8.6
Bonne Femme #1	18.3	7.5	401	7.5	6.1
Bonne Femme #2	16.7	7.2	406	7.5	3.4

Table 4
In situ Water Quality Measurements at all Stations (Spring 2002)

Creek/Station	Parameter				
	Temp.	Diss. O_2	Cond.	pH	Turb.
Hinkson #1	11.2	11.1	720	8.1	4.9
Hinkson #2	10.4	11.6	668	8.0	5.0
Hinkson #3	10.1	10.9	667	8.2	5.2
Hinkson #4	9.2	12.5	673	8.8	6.2
Hinkson #5	9.0	10.7	649	8.6	7.6
Hinkson #6	8.7	10.4	741	8.4	6.2
Hinkson #7	8.0	10.7	571	8.4	12.1
Hinkson #8	7.9	10.1	527	8.2	15.1
Bonne Femme #1	7.9	11.7	410	--	2.3
Bonne Femme #2	7.3	12.0	403	--	1.9

Nutrient concentrations as well as chloride concentrations are presented in Tables 5 (Fall 2001) and 6 (Spring 2002). Total phosphorus concentrations were near or below the detection limit of 0.05 mg/L at all stations during both survey periods. Nitrate/nitrite levels were generally higher in samples from fall 2001. No clear longitudinal pattern for this parameter was evident, nor did levels differ markedly between samples from Hinkson and Bonne Femme creeks. Total Kjeldahl nitrogen concentrations were similar among samples collected in each survey period, and did not conform to a longitudinal pattern of increase or decrease. However, TKN levels were consistently higher at Hinkson Creek stations than those of Bonne Femme Creek. Chloride concentrations were generally greater in spring 2002 than in the previous fall. On Hinkson Creek, chloride concentrations increased from upstream to downstream stations. Chloride levels were comparable among samples from upper Hinkson Creek and Bonne Femme Creek. Lower Hinkson Creek chloride concentrations were noticeably higher, however, than those at Bonne Femme Creek. At all stations in both survey periods, chloride levels were well below the chronic criteria for protection of aquatic life and drinking water supply.

Table 5
Nutrient Concentrations at all Stations (Fall 2001)

Creek/Station	Parameter				
	NH_3-N	NO_3/NO_2-N	TKN	Total Phos.	Chloride
Hinkson #1	*	0.25	0.36	0.06	36.2
Hinkson #2	*	0.26	0.46	0.08	36.4
Hinkson #3	*	0.25	0.73	0.10	36.2
Hinkson #4	*	0.26	0.52	0.10	46.7
Hinkson #5	*	0.13	0.54	*	34.5
Hinkson #6	*	0.25	0.45	0.05	24.9
Hinkson #7	*	0.05	0.44	*	13.9
Hinkson #8	*	*	0.51	0.05	7.7
Bonne Femme #1	*	0.23	0.22	0.05	10.1
Bonne Femme #2	*	0.22	*	0.06	10.1

*Below detection limits

Table 6
Nutrient Concentrations at all Stations (Spring 2002)

Creek/Station	Parameter				
	NH_3-N	NO_3/NO_2-N	TKN	Total Phos.	Chloride
Hinkson #1	*	*	0.39	*	64.3
Hinkson #2	*	*	0.37	*	54.0
Hinkson #3	*	*	0.49	*	53.4
Hinkson #4	*	0.05	0.43	0.05	55.0
Hinkson #5	*	*	0.42	0.06	46.5
Hinkson #6	*	*	0.40	*	56.9
Hinkson #7	*	0.11	0.52	0.06	26.7
Hinkson #8	*	0.05	0.62	*	23.4
Bonne Femme #1	*	*	*	*	24.3
Bonne Femme #2	*	*	*	*	24.5

*Below detection limits

5.2 Habitat Assessment

Habitat assessment scores were recorded for each sampling station. Results are presented in Table 7. According to the project procedure, for a study site to fully support a biological community, the total score from the physical habitat assessment should be 75% to 100% similar to the total score of the reference site. The mean habitat score for the two Bonne Femme Creek

sites was 110.5; when the habitat scores for three reference sites was included, the average across all reference sites used in the study was 120. All Hinkson Creek stations had habitat scores which exceeded or were well within the aforementioned range of similarity. It was therefore inferred that the sites should support comparable biological communities.

Table 7
Reference Streams and Hinkson Creek Habitat Assessment Scores

Reference Streams	Habitat Score	Hinkson Creek	Habitat Score	% of Mean Ref.
Bonne Femme #1	104	Station #1	106	88%
Bonne Femme #2	117	Station #2	115	96%
Moniteau Creek	129	Station #3	114	95%
Burris Fork	121	Station #4	136	113%
Heaths Creek	129	Station #5	133	111%
		Station #6	119	99%
		Station #7	116	97%
		Station #8	110	92%
Mean Ref. Stream Score	**120**			

5.3 Biological Assessment

5.3.1 Hinkson Creek Longitudinal Comparison

The upstream Hinkson Creek macroinvertebrate community (Stations 6-8) was compared with the downstream community (Stations 1-3) to observe whether changes occur in the stream while flowing from a mostly rural landscape through an increasingly urbanized setting. Generally there was a weak increase among most biologic indices progressing downstream in fall 2001 (Table 8) which was sufficient to elevate the sustainability ranking from partial to full at Station 5 and all stations downstream. This trend was reversed, however, in spring 2002 (Table 9), with indices generally lower at downstream stations. A notable change was observed in the Spring 2002 EPT Taxa between Stations 7 and 6, in which the taxa dropped from 17 to 7, respectively (see Figure 2). In addition, the number of total taxa dropped by 19 in the same reach, gradually increasing in downstream stations but never recovering to the taxa richness observed upstream (see Figure 3). The sustainability ranking also exhibited a sharp drop at this point, falling from a fully sustaining score of 18 to a partially sustaining score of 12 (see Table 9). Sustainability rankings between 20-16 qualify as fully sustaining, between 14-10 are partially sustaining, and 8-4 are considered nonsustaining of aquatic life.

Table 8
Hinkson Creek Metric Values and Scores, Fall 2001 Season, Using Ozark/Moreau/Loutre Biocriteria Reference Database

Site #	TT	EPTT	BI	SDI	T-Score	Sustain.
#8 Value	63	10	7.30	2.68		
#8 Score	3	3	3	3	12	**Partial**
#7 Value	63	9	7.31	2.58		
#7 Score	3	3	3	3	12	**Partial**
#6 Value	68	9	7.21	2.97		
#6 Score	3	3	3	3	12	**Partial**
#5 Value	64	13	6.62	3.44		
#5 Score	3	3	5	5	16	**Full**
#4 Value	76	10	6.66	3.20		
#4 Score	5	3	5	5	18	**Full**
#3 Value	90	12	6.87	3.38		
#3 Score	5	3	5	5	18	**Full**
#2 Value	79	8	7.02	3.19		
#2 Score	5	3	5	5	18	**Full**
#1 Value	65	13	6.67	3.17		
#1 Score	3	3	5	5	16	**Full**

Figure 2: Hinkson Creek EPT Taxa

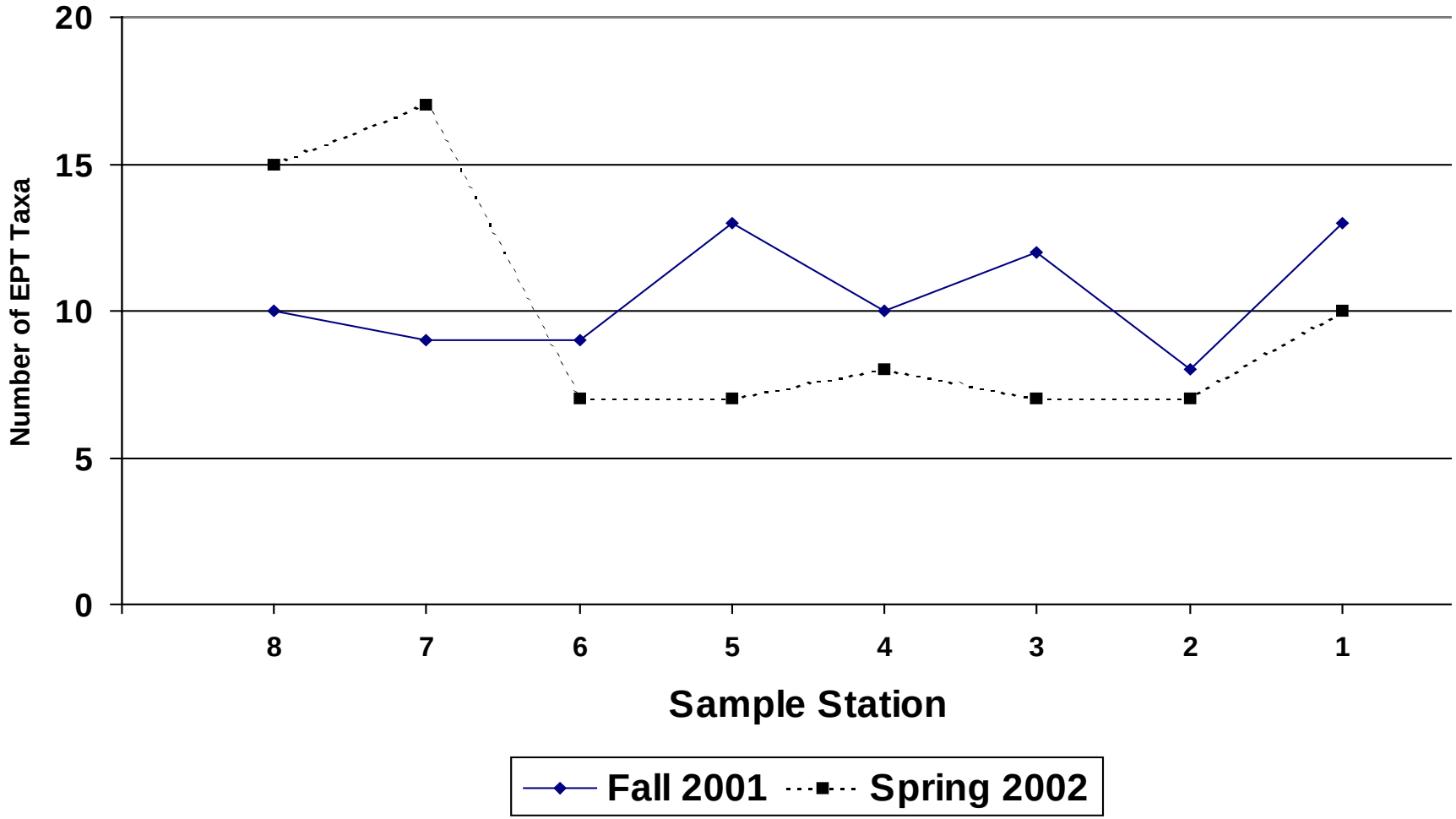


Figure 3: Hinkson Creek Total Taxa

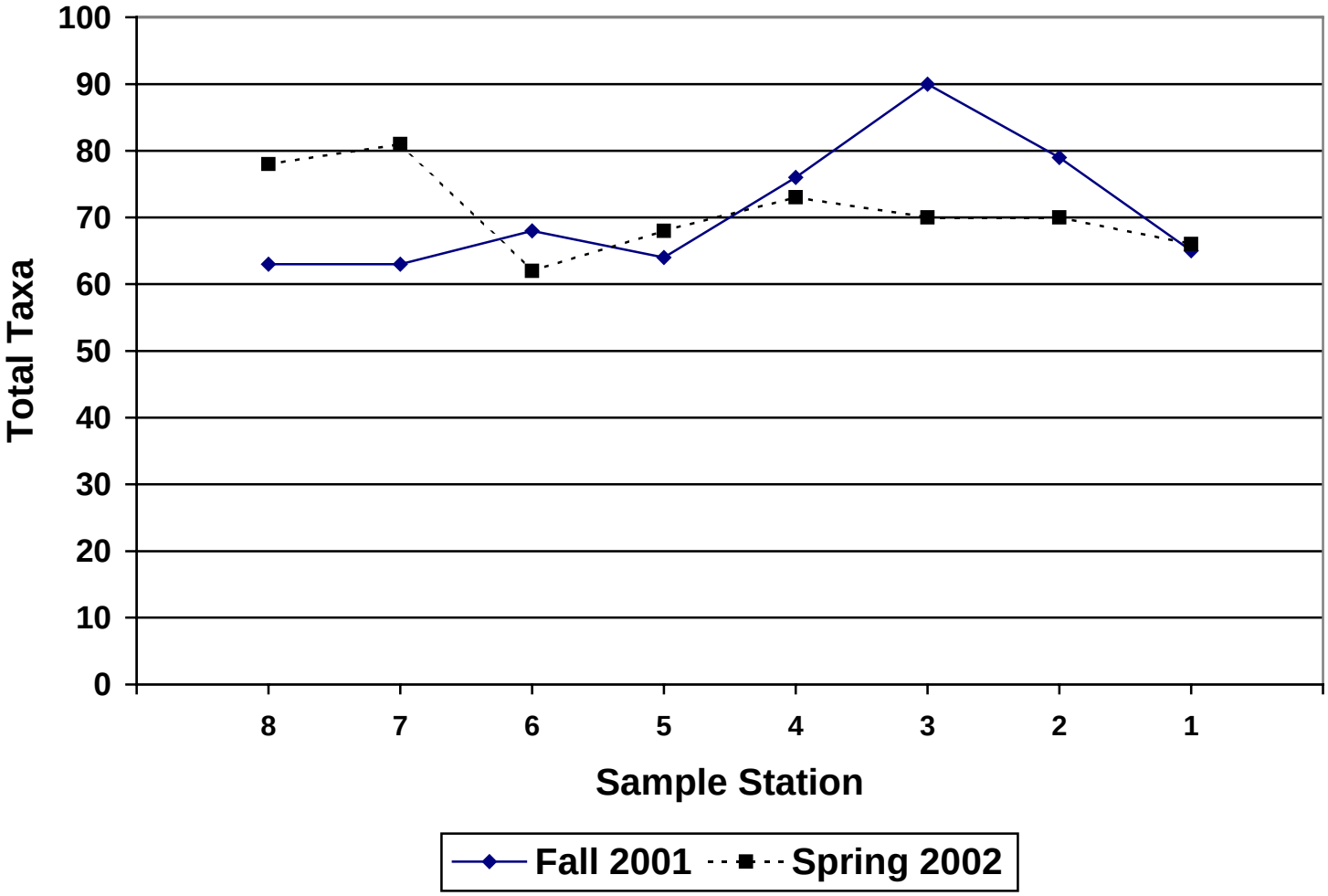


Table 9
Hinkson Creek Metric Values and Scores, Spring 2002 Season, Using Ozark/Moreau/Loutre Biocriteria Reference Database

Site #	TT	EPTT	BI	SDI	T-Score	Sustain.
#8 Value	78	15	6.86	2.89		
#8 Score	5	5	3	5	18	**Full**
#7 Value	81	17	6.77	2.93		
#7 Score	5	5	3	5	18	**Full**
#6 Value	62	7	7.06	2.59		
#6 Score	3	3	3	3	12	**Partial**
#5 Value	58	7	7.02	2.63		
#5 Score	3	3	3	3	12	**Partial**
#4 Value	73	8	7.12	2.61		
#4 Score	5	3	3	3	14	**Partial**
#3 Value	70	7	7.32	3.20		
#3 Score	3	3	3	5	14	**Partial**
#2 Value	70	7	7.22	3.16		
#2 Score	3	3	3	5	14	**Partial**
#1 Value	66	10	7.16	2.97		
#1 Score	3	3	3	5	14	**Partial**

5.3.2 Comparison of Upper and Lower Hinkson Creek versus Bonne Femme Creek

The means of Total Taxa, EPT Taxa, and Stream Condition Index were most similar between the lower Hinkson Creek stations and Bonne Femme Creek during fall 2001 (see Figures 4 and 5). There was also little difference among seasons and streams (both upper and lower Hinkson versus Bonne Femme) for Biotic Index and Shannon Diversity Index. The means of Total Taxa, EPT Taxa, and Stream Condition Index were higher at Bonne Femme Creek than for upper Hinkson during fall 2001.

There were more noticeable differences among biological indices for spring 2002. Whereas mean Total Taxa, EPT Taxa, and Stream Condition Index were comparable among lower Hinkson and Bonne Femme creeks during the fall 2001 sample season, these indices were consistently lower at Hinkson Creek during the spring. The means for each of the previously

Figure 4: Mean Total Taxa at Upper and Lower Hinkson Creek and Bonne Femme Creek, Fall 2001 and Spring 2002

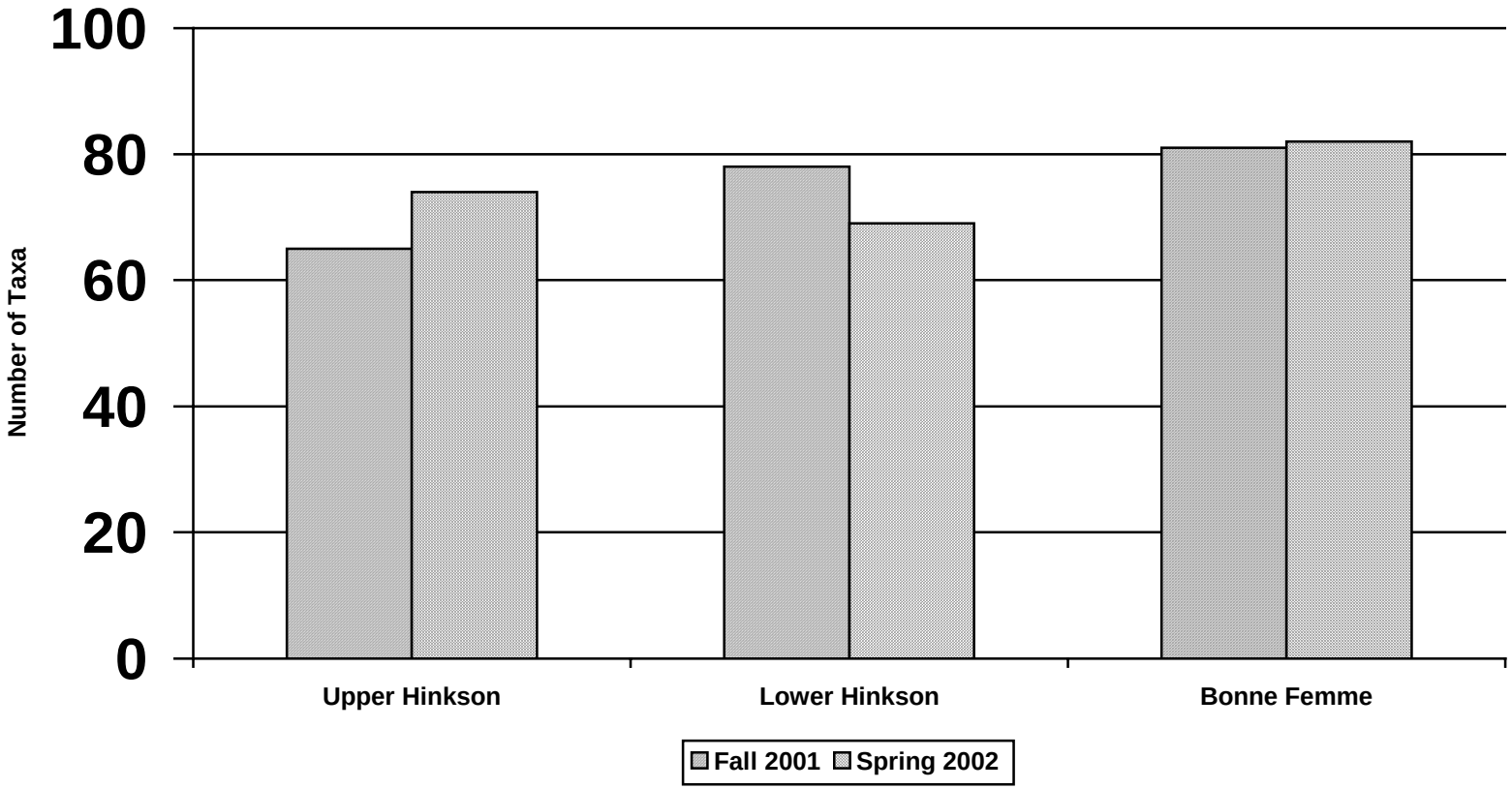
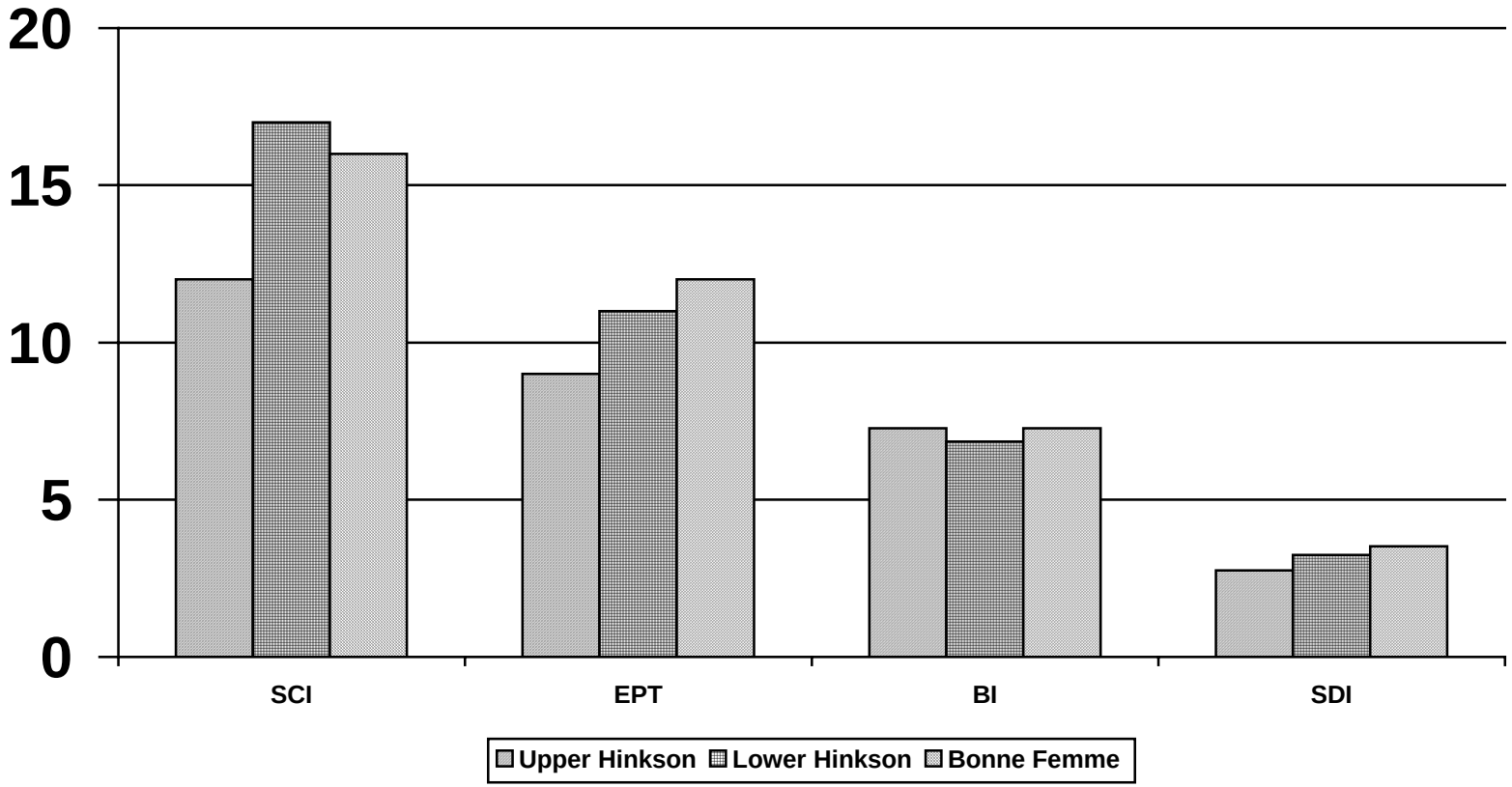


Figure 5: Comparison of Mean Values between Upper Hinkson, Lower Hinkson, and Bonne Femme Creek (Fall 2001)



mentioned indices for upper Hinkson Creek were lower than those for Bonne Femme for both fall 2001 and spring 2002 (Figures 4, 5, and 6).

Table 10
Bonne Femme Creek Metric Values and Scores, Fall 2001 Season, Using Ozark/Moreau/Loutre Biocriteria Reference Database

Site #	TT	EPTT	BI	SDI	T-Score	Sustain.
#2 Value	82	11	7.17	3.56		
#2 Score	5	3	3	5	16	**Full**
#1 Value	79	13	7.36	3.45		
#1 Score	5	3	3	5	16	**Full**

Table 11
Bonne Femme Creek Metric Values and Scores, Spring 2002 Season, Using Ozark/Moreau/Loutre Biocriteria Reference Database

Site #	TT	EPTT	BI	SDI	T-Score	Sustain.
#2 Value	81	15	6.41	3.12		
#2 Score	5	5	5	5	20	**Full**
#1 Value	83	17	6.43	2.95		
#1 Score	5	5	5	5	20	**Full**

5.3.3 Comparisons of Hinkson and Bonne Femme Creeks versus Ozark/Moreau/Loutre EDU Biocriteria Reference Sites

Metrics calculated for Hinkson and Bonne Femme creeks were compared to biological criteria derived for the Ozark/Moreau/Loutre EDU Biocriteria Reference Sites. These criteria are listed for the spring and fall sampling seasons in Tables 12 and 13, respectively. This comparison was made to assess the degree to which using biological criteria was applicable for Hinkson and Bonne Femme creeks. Most of the biocriteria reference streams are fourth and fifth order, whereas Hinkson and Bonne Femme creek survey sites were second and third order. Larger streams may have more available habitat and higher numbers of macroinvertebrate taxa and diversity than smaller streams. The four metrics calculated for the fall and spring sample seasons at Hinkson (Tables 8 and 9) and Bonne Femme creeks (Tables 10 and 11) were comparable and, in some cases, better than the biological criteria reference metrics. Although upper Hinkson Creek (Stations 6-8) had very low flows (mean among the three sites was 0.76 cfs) during fall 2001, each site was categorized as partially sustaining for aquatic life with total scores of 12. All other sites on Hinkson Creek during both seasons had equal or higher total scores and sustainability ratings. Bonne Femme Creek stations were fully supporting during both seasons.

Figure 6: Comparison of Mean Values between Upper Hinkson, Lower Hinkson, and Bonne Femme Creek (Spring 2002)

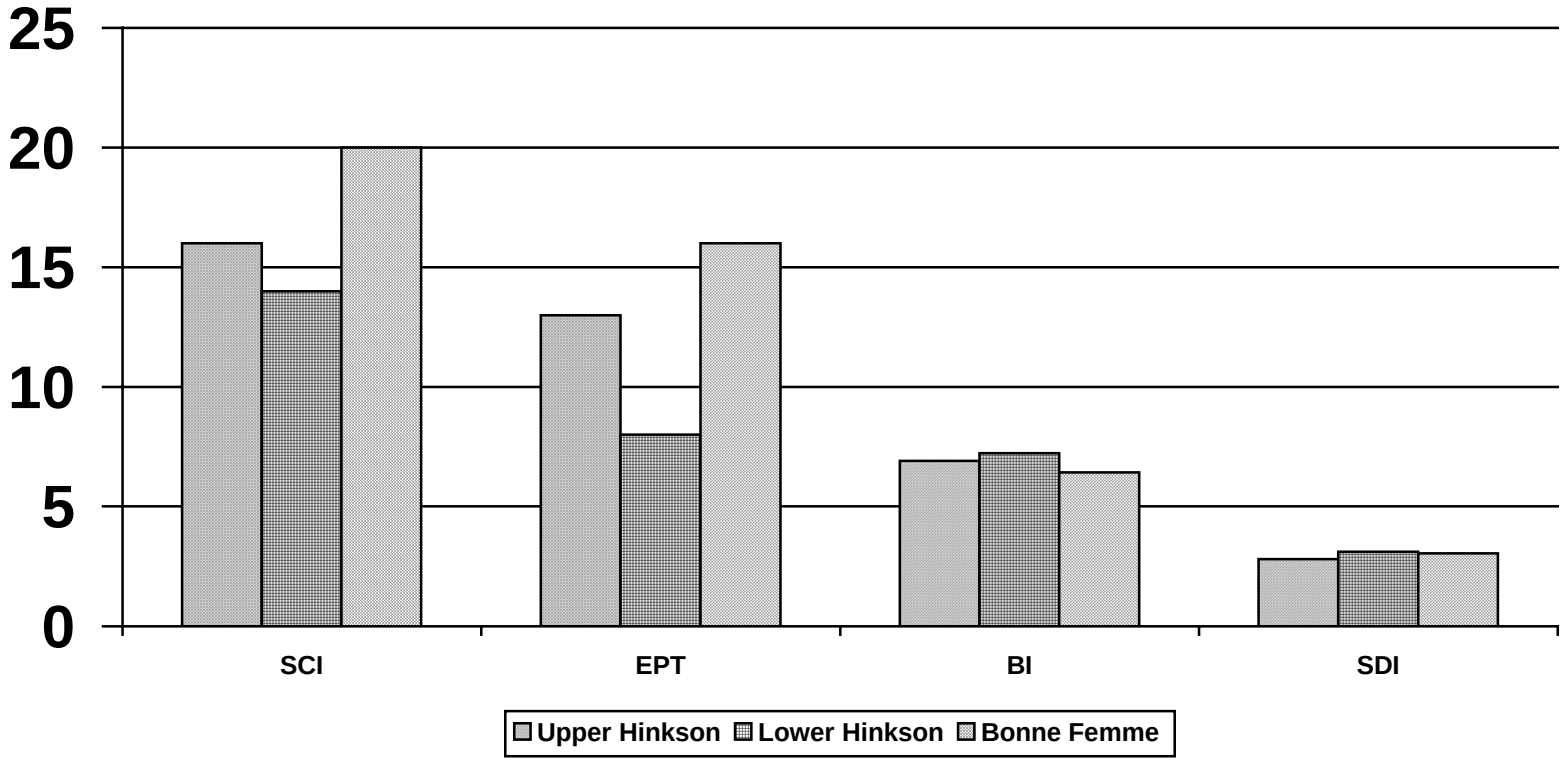


Table 12
Biological Criteria for Warm Water Reference Streams Database in the Ozark/Moreau/Loutre EDU Fall Season

	Score = 5	Score = 3	Score = 1
TT	>68	68-34	33-0
EPTT	>13	13-6	5-0
BI	<7.09	7.09-8.54	8.55-10
SI	>3	3-1.5	1.4-0

Table 13
Biological Criteria for Warm Water Reference Streams Database in the Ozark/Moreau/Loutre EDU Spring Season

	Score = 5	Score = 3	Score = 1
TT	>70	70-35	34-0
EPTT	>13	13-6	5-0
BI	<6.49	6.49-8.54	8.25-10
SI	>2.8	1.4	1.3-0

5.3.4 Macroinvertebrate Percent and Community Composition

The number of macroinvertebrate total taxa, EPT taxa, and percent EPT are presented in Tables 14 and 15. These tables also provide percent composition data for the five dominant macroinvertebrate families at each Hinkson and Bonne Femme creek station. The percent of relative abundance data were averaged from the sum of the three macroinvertebrate habitats (coarse substrate, nonflow, and rootmat) sampled at each station.

Fall 2001 macroinvertebrate samples from Hinkson Creek control Station 8 contained 63 total taxa and 10 EPT Taxa (Table 14). Test Station 1, downstream of all suspected urban influences, had 65 total taxa and 13 EPT Taxa. A total of four Ephemeroptera (mayfly) taxa made up 52.0 percent of samples at Station 8. Of the four mayfly taxa, two families, square gill (Caenidae) and flatheaded (Heptageniidae) mayflies made up 50.9 percent of these samples. At Hinkson Creek Station 1, nine mayfly taxa and four caddisfly taxa made up16.4 and 22.5 percent of samples, respectively. Small minnow mayflies (Baetidae) and netspinner caddisflies (Hydropsychidae) combined to make up 33.6 percent of the samples at Station 1. Chironomidae (midge) larvae generally comprised a greater percentage of samples in downstream samples (i.e., stations 1-6), though no distinct trend was evident. Caenid and heptagenid mayflies, chironomids, and riffle beetles (Elmidae) were most consistently the dominant taxa among all Hinkson Creek fall samples. The relative abundance of Caenidae generally decreased while progressing downstream, but no such trend was observed with Heptageniidae. Aquatic worms (Tubificidae) were counted among the dominant taxa at three Hinkson Creek stations. The fact that tubificid worms ranked among the dominant taxa at Station 5, however, is likely a result of no rootmat sample having been collected at this site. A lower total number of individuals in this sample plus

Table 14: Fall 2001Hinkson and Bonne Femme Creek Macroinvertebrate Composition

	Hinkson Creek Test Stations								Bonne Femme Creek Control Stations	
Variable-Station	8	7	6	5	4	3	2	1	2	1
Total Taxa	63	63	68	64	76	90	79	65	82	79
Number EPT Taxa	10	9	9	13	10	12	8	13	11	13
% Ephemeroptera	52.0	54.5	25.8	27.4	23.3	16.7	23.6	16.4	14.3	13.1
% Plecoptera	-	-	-	-	-	-	-	-	-	-
% Trichoptera	1.3	1.3	5.1	4.2	4.0	14.6	7.2	22.5	1.9	2.8
% Dominant Families										
Chironomidae	14.4	14.2	17.1	32.3	19.3	29.4	21.3	37.0	37.6	32.7
Caenidae	37.7	38.2	23.1	8.9	10.0	-	7.7	-	8.4	7.7
Elmidae	6.5	9.1	13.7	14.2	27.7	15.1	23.9	9.7	13.4	14.3
Heptageniidae	13.2	14.8	-	12.4	9.0	-	9.2	-	-	-
Hyalellidae	7.8	7.8	-	-	-	-	-	-	5.0	-
Physidae	-	-	6.7	-	-	-	-	-	-	-
Tubificidae	-	-	-	4.0	8.3	-	12.1	-	15.7	12.3
Baetidae	-	-	-	-	-	11.5	-	13.0	-	-
Hydropsychidae	-	-	-	-	-	14.3	-	20.6	-	-
Coenagrionidae	-	-	5.3	-	-	7.1	-	6.9	-	-
Planariidae	-	-	-	-	-	-	-	-	-	6.0

a lack of the organisms normally found in rootmat habitat may have caused tubificids to be over represented. No Plecoptera (stoneflies) were collected in any Hinkson Creek fall samples.

Spring 2002 Hinkson Creek macroinvertebrate samples exhibited markedly different species composition and relative abundances compared to the fall samples. At most stations, the relative abundance of chironomid larvae in spring samples was at least triple that of fall samples (Table 15) whereas the proportion of mayflies in spring samples was a fraction of what was collected in fall samples. Control Station 8 contained 78 total taxa and 15 EPT Taxa; Station 1 contained 66 total taxa and 10 EPT Taxa. The proportion of caddisfly larvae collected at Hinkson Creek stations 8 and 7 in spring samples was similar to corresponding stations in fall samples. At Station 6 and downstream throughout the study reach, however, the percentage of caddisflies present in samples was much lower in the spring. Plecoptera were collected only at Hinkson Creek stations 8 and 7. At Station 8, three stonefly taxa made up 1.3 percent of the sample; at Station 7, four stonefly taxa made up 1.5 percent of the sample. Tubificid worms were ranked among the five most dominant taxa at all but site 8 in samples collected in spring 2002.

Fall 2001 macroinvertebrate samples from Bonne Femme Creek, the regional reference stream, exhibited roughly similar total taxa and EPT Taxa compared to Hinkson Creek (Table 14). Although the Bonne Femme EPT Taxa scores were equal to or higher than those from the Hinkson Creek sites, mayflies and caddisflies made up a lower percentage of the total number of individuals in the samples. At Bonne Femme Station 2, six mayfly taxa made up 14.3 percent of the samples and at Station 1, six mayfly taxa made up 13.1 percent of samples. Chironomidae taxa made up a higher proportion of samples at Bonne Femme than all but one Hinkson Creek site. Tubificid worms were the second and third most abundant taxa at Bonne Femme Creek sites 2 and 1, respectively, and account for a higher proportion of individuals than any of the Hinkson Creek samples. As with Hinkson Creek, no stoneflies were present in Bonne Femme Creek fall samples.

Total taxa was largely unchanged in spring 2002 Bonne Femme Creek samples compared to the fall samples, but the number of EPT Taxa increased due to the addition of several stonefly taxa (Table 15). At Station 2, four mayfly taxa made up 6.9 percent of samples and at Station 1, six mayfly taxa made up 9.8 percent of samples. The number of caddisfly taxa increased at Station 2 in spring samples from four (in fall samples) to nine taxa, making up 1.7 percent of samples. At Station 1, however, the number of caddisfly taxa decreased from six to three taxa, making up 0.9 percent of samples. A single stonefly taxon, *Isoperla* sp., made up 7.6 percent of individuals in samples from Bonne Femme site 2 and 10.5 percent at site 1. Although there were three additional stonefly taxa present in samples from Bonne Femme Creek, each was represented by five or fewer individuals. Chironomidae taxa comprised a higher proportion of samples in spring compared to fall, approximately double at both sites.

Macroinvertebrate data for five biocriteria reference streams sampled in spring and fall 2001 are presented in Table 16. Three of the streams (Boeuf Creek, Loutre River, and Moniteau Creek)

Table 15: Spring 2002 Hinkson and Bonne Femme Creek Macroinvertebrate Composition

	Hinkson Creek Test Stations								Bonne Femme Creek Control Stations	
Variable-Station	8	7	6	5	4	3	2	1	2	1
Total Taxa	78	81	62	58	73	70	70	66	81	83
Number EPT Taxa	15	17	7	7	8	7	7	10	17	15
% Ephemeroptera	18.9	15.5	7.4	7.1	6.7	5.8	5.5	3.8	6.9	9.8
% Plecoptera	0.8	1.2	-	-	-	-	-	-	7.8	11.0
% Trichoptera	1.3	1.5	0.8	1.1	0.5	1.0	0.5	0.8	1.7	0.9
% Dominant Families										
Chironomidae	51.4	70.2	69.6	79.9	81.9	68.9	67.1	84.4	58.2	64.4
Caenidae	13.2	12.4	2.9	3.1	3.7	4.0	3.5	1.8	3.8	-
Elmidae	13.5	3.6	10.0	5.6	3.9	5.7	11.6	4.2	3.8	7.8
Heptageniidae	3.8	-	-	3.3	2.2	-	-	1.2	5.3	4.0
Hyalellidae	4.3	1.6	-	-	-	-	-	-	-	-
Tubificidae	-	1.5	3.6	2.3	2.9	10.2	8.6	4.7	3.9	3.6
Baetidae	-	-	3.3	-	-	-	-	-	-	-
Coenagrionidae	-	-	-	-	-	2.6	3.0	-	-	-
Perlodidae	-	-	-	-	-	-	-	-	10.5	7.6

Table 16: Ozark/Moreau/Loutre EDU Biocriteria Reference Stream Macroinvertebrate Composition (2001)

	Boeuf Creek		Heaths Creek		Loutre River		Moniteau Creek		Richland Creek	
Variable-Season	Spring 2001	Fall 2001	Spring 2001	Fall 2001	Spring 2001	Fall 2001	Spring 2001	Fall 2001	Spring 2001	Fall 2001
Total Taxa	71	77	66	81	68	74	70	79	71	80
Number EPT Taxa	19	14	8	15	9	13	13	13	13	20
% Ephemeroptera	38.2	34.3	20.0	25.2	37.8	31.4	10.5	21.6	5.4	31.2
% Plecoptera	9.1	-	9.3	-	-	-	15.1	-	20.4	0.3
% Trichoptera	3.1	6.0	0.4	17.5	0.6	2.7	1.0	6.3	0.6	10.0
% Dominant Families										
Chironomidae	35.2	34.8	30.1	27.6	50.6	51.9	33.4	22.4	53.0	26.3
Caenidae	26.4	21.0	15.3	12.4	33.0	19.4	9.1	7.1	5.1	18.7
Elmidae	-	5.6	20.7	-	2.6	1.9	13.2	15.5	-	-
Perlodidae	-	-	-	-	-	-	14.1	-	-	-
Chloroperlidae	6.9	-	-	-	-	-	-	-	18.1	-
Heptageniidae	-	-	-	7.9	3.8	-	-	-	-	7.2
Baetidae	8.3	-	-	-	-	7.8	-	-	-	-
Tricorythidae	-	12.0	-	-	-	-	-	-	-	-
Hydropsychidae	-	3.7	-	17.1	-	-	-	-	-	-
Coenagrionidae	-	-	-	-	-	5.9	-	7.6	-	9.9
Hyalellidae	4.5	-	3.6	6.4	-	-	-	-	3.4	6.3
Crangonyctidae	-	-	-	-	-	-	-	-	3.6	-
Tubificidae	-	-	6.3	-	3.2	-	14.6	9.5	-	-

are within the Ozark/Moreau/Loutre (O/M/L) EDU, which also includes Hinkson Creek. The remaining two (Heaths and Richland creeks) are on the eastern border of the Plains/Missouri Tributaries between the Blue and Lamine Drainages EDU and were considered transition streams between the two EDUs for this study. One biocriteria reference stream within the O/M/L EDU, Burris Fork, was excluded for lack of fall 2001 data.

Total taxa for the biocriteria reference streams ranged from 66 to71 during spring 2001 and from 74 to 81 during fall 2001. Total EPT Taxa ranged from 8 to 19 in spring samples and from 13 to 20 during fall. Percent Ephemeroptera remained relatively stable among seasons for all sites except Moniteau and Richland creeks, which exhibited much higher mayfly proportions in the fall. The reverse trend was true for percent Plecoptera; stoneflies were absent in all fall samples except Richland Creek (in which four immature larvae were collected), then rebounded to make up between 9 and 20 percent of samples. The proportion of caddisflies in fall samples was higher than that of spring samples in each of the reference streams observed. Relative abundance of Chironomidae taxa was stable among seasons for all reference streams except Richland Creek, in which case chironomids were twice as dominant in spring samples as fall.

6.0 Discussion

Water quality sample results from Hinkson and Bonne Femme creeks did not reveal many definitive trends. As expected, there were seasonal changes in some parameters. In particular, temperature, turbidity, and nitrate-nitrite were generally higher in fall whereas dissolved oxygen, conductivity, and chloride were higher in the spring. In comparing the two creeks, Hinkson Creek water quality samples showed consistently higher conductivity, turbidity, and total Kjeldahl nitrogen values than Bonne Femme Creek. Overall, chloride levels were comparable among sites except when comparing only lower Hinkson (stations 1-3) versus Bonne Femme Creek. The lower Hinkson Creek reach was downstream of Grindstone Creek, a receiving system for four permitted wastewater treatment facilities (combined design flow of 0.078 mgd), which likely resulted in water samples having higher chloride levels for both seasons. No other strong trends, relative to stream gradient, were observed in water quality on Hinkson Creek for either season.

Two points of interest were observed in Hinkson Creek water quality samples. First, during the fall sample season, conductivity was more than twice as high at Station 7 compared to either station upstream or downstream from it. The only major difference is the presence of the City of Columbia Sanitary Landfill, which lies downstream of Station 8 and upstream of Station 7. Second, compared to fall samples, spring conductivity levels were higher and turbidity levels were generally lower despite substantially greater stream flow.

Despite flowing through a watershed with greater urban influence than reference streams within the O/M/L EDU, habitat scores for Hinkson Creek sample sites were at least 88% of the average of reference streams. Three Hinkson Creek sites chosen were at or near parks or greenways in

Columbia (Stations 2, 4, and 5); the remainder were adjacent to other publicly owned or private property. Though the three sites adjacent to parks did have the highest habitat assessment scores, they were not completely anomalous when compared to the others. Overall, the Hinkson Creek sites had good, relatively wide riparian corridors, adequate vegetative protection, and stable banks. Despite seemingly adequate riparian habitat, effects of stormwater runoff, which would bypass much of the natural filtration provided by the riparian corridors, were observed. During heavy rain events, many wet weather gullies fed by runoff from parking lots and roads were observed flowing into Hinkson Creek.

Among the most dramatic changes observed during the study was the drop in total taxa and EPT Taxa between Hinkson Creek Stations 7 and 6 in spring 2002. Compared to the upstream station (#7), total taxa fell from 81 to 62 and EPT Taxa fell from 17 to 7 at Station 6. Total taxa made another slight drop at Station 5, but as mentioned in the Results section, this decrease is likely caused by the lack of adequate rootmat habitat for sampling.

Several factors that may act to degrade the Hinkson Creek biological community occur simultaneously at Station 6. The first factor is commingled stormwater runoff from the Walmart/Sam's Club/Lowes shopping center parking lot along with runoff from a Missouri Department of Transportation (**MoDOT**) maintenance facility, all of which are located southwest of the Highway 63/Interstate 70 intersection in Columbia. While conducting sampling during a heavy rain on September 18, 2001, we observed muddy stormwater entering the creek at several points along the left descending (east) bank. Soon after the leading edge of this stormwater entered the creek, we observed a strong odor of diesel fuel along with a rainbow sheen consistent with petroleum contamination on the water's surface. We followed the stormwater up the east bank of the creek to the MoDOT facility mentioned earlier, where we observed a large aboveground storage tank. Although this event was observed during the fall sample season, it is likely that similar events occurred during spring rains, possibly flushing various contaminants accumulated during the winter.

A second factor potentially contributing to the macroinvertebrate community decline at Station 6 is the Columbia Country Club golf course located along the right descending (west) bank of Hinkson Creek. The golf course borders approximately half of the reach sampled at Station 6. We have no evidence that stormwater from the golf course flowing into Hinkson Creek contained any contaminants; however golf courses generally employ the use of fertilizers and pesticides to maintain their appearance. It is likely that the Columbia Country Club uses these lawn chemicals to maintain their turf grasses.

A third potential source of degradation is Interstate 70, which crosses Hinkson Creek approximately 0.7 mi upstream of Station 6. It may be that de-icing agents applied to the highway over the winter along with the normal accumulation of petroleum and miscellaneous debris made their way into the creek with the spring rains.

A fourth factor to consider is periodic sewage bypasses that may occur in the vicinity. On August 22, 2001 a sewage bypass was investigated by the City of Columbia and the Missouri Department of Natural Resources. Sewage entered Hinkson Creek near the intersection of Clark Lane and Highway 63, approximately 0.8 mi upstream from Station 6. If this type of release is a recurring problem, occasional pulses of sewage may degrade the macroinvertebrate community without necessarily being detected in the water quality samples which were collected concurrent with our invertebrate samples.

Even if none of the factors mentioned above were the cause of the decline observed in the spring 2002 samples, they exemplify the change that occurs directly upstream of Station 6. This sample site is the first in the study reach that occurs where urbanization is a contributor to the edaphic conditions. The two stations upstream are in rural settings, where the only evidence of degradation is an increased conductivity reading at Station 7, possibly due to an inflow of leachate from Columbia's landfill.

Another notable characteristic of the macroinvertebrate data is the large increase that Chironomidae taxa contribute to the spring 2002 samples. Whereas chironomids make up an average of 23% of individuals among Hinkson Creek fall samples (range 14.2-37.0), they averaged 72% in spring samples (range 51.4-84.4). This increase in the proportion of chironomid taxa also was observed in Bonne Femme Creek samples, the local control site. When looking at 2001 samples from bioreference sites across the O/M/L EDU, however, chironomid proportions in samples were more stable across seasons.

7.0 Conclusions

Upper and lower Hinkson Creek macroinvertebrate communities were comparable during fall 2001, with lower Hinkson having a higher average total taxa, but a lower percentage of mayfly taxa. The average percentage of caddisfly individuals contributing to samples at the lower three stations, however, was much higher than the uppermost three stations. During spring 2002, the Hinkson Creek longitudinal trends for total taxa and percent mayflies were opposite that observed in fall samples. Macroinvertebrate metrics were not noticeably affected by the Columbia landfill (Station 7 versus 8). Comparing Hinkson Creek upstream of Grindstone Creek (Station 5) versus downstream (Station 4) appeared to show an increase in total taxa for both seasons. The difference in total taxa at this point in the reach, however, was largely explained by the lack of a rootmat sample at Station 5. Both fall 2001 and spring 2002 samples from Station 4, for example, had 10 taxa that were found exclusively in rootmat habitat. If those taxa were added to the total taxa list at Station 5, the difference between stations bracketing Grindstone Creek would have been negligible. Total taxa and EPT Taxa showed a noticeable decrease at Hinkson Creek Station 6 and the remaining stations downstream in the spring 2002 samples. In addition, samples from these stations showed a decrease in mayfly taxa and a complete elimination of stonefly taxa.

The Hinkson Creek macroinvertebrate community was comparable to Bonne Femme Creek fall 2001 samples, with the only notable exception being that tubificid worms comprised a higher proportion of samples at Bonne Femme Creek. During spring 2002, total taxa and EPT Taxa at the uppermost two Hinkson Creek stations were similar to Bonne Femme Creek. Mayflies made up the majority of EPT individuals at the upper two Hinkson Creek stations, whereas stoneflies were the primary contributor to this metric at Bonne Femme Creek.

Comparing Hinkson Creek with five biocriteria reference sites did not yield any definite patterns. Total taxa and EPT taxa scores from Hinkson Creek were neither better nor worse than the reference sites taken as a whole. Fluctuations in chironomid proportions among seasons were more pronounced than at most of the reference streams, but this phenomenon also was observed at our regional reference site, Bonne Femme Creek. It is curious to note that these fluctuations take place but not completely out of the ordinary, given that they occurred at our regional reference site and on one of the biocriteria reference streams.

8.0 Recommendations

Prevent stormwater runoff from the shopping center east of Hinkson Creek Station 6 and the MoDOT maintenance facility near the I-70/U.S. 63 intersection from flowing directly into the creek. This recommendation could be met by constructing a stormwater retention basin to allow for the attenuation of flows and potential settling out of some contaminants.

Conduct a small scale survey surrounding Station 6 to determine whether the drop in Total Taxa and EPT Taxa observed during the spring 2002 sample season was a singular event or a recurring seasonal phenomenon. Include stormwater sampling in the survey.

9.0 Summary

1. Total Taxa and EPT Taxa exhibited a sharp drop in the urbanized portion of Hinkson Creek when compared to the upstream sample stations in spring 2002.

2. In spring 2002, stoneflies were present in samples collected from the upstream two stations; at stations within the urbanized reach, however, stoneflies were absent.

3. The Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP) found that during fall 2001 the macroinvertebrate community of Hinkson Creek was partially sustaining in the upstream three sample sites and fully sustaining at the remaining five downstream sites. During the spring 2002 samples season this trend was reversed; the macroinvertebrate community at the upper two stations were fully sustaining, whereas the downstream six stations were partially sustaining. A lack of water in upper Hinkson Creek may have contributed to the difference.

4. Habitat scores among Hinkson Creek sample sites were comparable to scores at Bonne Femme Creek control sites and reference sites within the Ozark/Moreau/Loutre EDU.

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Appendix A

Proposed Bioassessment Study Plan
Hinkson Creek
August 9, 2001

Missouri Department of Natural Resources

Bioassessment Study Plan
Hinkson Creek, Boone County
August 9, 2001

Objectives

Hinkson Creek flows through an urban watershed, namely Columbia, Missouri. It has been placed on the 303(d) list due to concerns related to that situation. These concerns include the potential for water quality degradation due to stormwater runoff and the likely detrimental effects of development on the stream channel and riparian areas. We therefore propose to conduct a bioassessment of the macroinvertebrate community of Hinkson Creek. Our objectives are to determine: 1) whether there is greater aquatic life impairment in the most urbanized portions of the creek relative to sections upstream of that area; and 2) whether aquatic life in Hinkson Creek is impaired relative to that of regional reference streams.

Null Hypotheses

1) The macroinvertebrate assemblages will not differ between longitudinally separate reaches of Hinkson Creek.

2) Macroinvertebrate assemblages will not significantly differ between Hinkson Creek and similar sized reaches of reference streams within the Ozark-Middle Missouri Ecological Drainage Unit (EDU).

Background

Urban streams are particularly vulnerable to water quality and habitat degradations. Water quality could be reduced by wastewater treatment plant discharges, accidental or deliberate spills, and illegal dumping. Habitat losses often result from residential or commercial development. It is believed that the biological integrity of Hinkson Creek, which flows through Columbia, may be threatened by the pace and extent of development in the area.

Study Design

General: The study area includes approximately 15 miles of Hinkson Creek. The upstream boundary of the Hinkson Creek study area is just upstream of the Columbia landfill near the Rogers Road bridge, while the downstream boundary is just downstream of the Scotts Boulevard bridge near the southwest corner of the city. Eight Hinkson Creek stations will be surveyed. The general locations are as follows: 1) just upstream of the landfill; 2) just downstream of the landfill; 3) downstream of the Interstate 70 crossing at the East Walnut Street bridge; 4) upstream of the entrance of Grindstone Creek into Hinkson Creek; 5) just downstream of the Grindstone Creek entrance; 6) near the Forum Boulevard bridge; 7) near the Twin Lakes Recreational Area; and 8) downstream of the Scotts Boulevard bridge. In addition to regional reference streams, three Bonne Femme Creek stations will be surveyed between Three Creeks Conservation Area and the entrance of Fox Hollow Branch. Bonne Femme Creek flows through a rural watershed and does not receive urban stormwater runoff. It was selected using criteria for the establishment of reference stream conditions and will be used as a local reference stream for the purpose of this study. A local reference is necessary because the Ozark-Middle Missouri EDU is a transition area between ozark and prairie conditions. Existing regional reference streams may not be appropriate depending upon soil and geological characteristics.

Each station will consist of a length approximately 20 times the average stream width, and will contain at least two riffle areas, as outlined in MDNR-FSS-032. In order to assess variability among sampling stations, stream discharge, habitat assessment, and water chemistry will be determined during macroinvertebrate surveys. Sampling will be conducted during the fall of 2001 (September 15 through October 15) and spring 2002 (March 15 through April 15).

Biological Sampling Methods: Macroinvertebrates will be sampled as per the guidelines of the Semi-Quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP). Hinkson and Bonne Femme creeks will be

considered “riffle/pool” predominant streams; therefore samples will be collected from flow over coarse substrate, depositional (non-flow), and root-mat habitats. Each macroinvertebrate sample will be a composite of six subsamples within each habitat.

Habitat Sampling Methods: Stream discharge will be measured at each sampling location using a Marsh-McBirney flow meter. Stream habitat assessments will also be conducted within each study area following the guidelines of MDNR-FSS-032.

Water Quality Sampling Methods: Water samples from all sampled stations will be analyzed at the ESP laboratory for ammonia, nitrogen as NO_2 +NO_3, total Kjeldahl nitrogen, total phosphorus, chloride, and turbidity. Field measurements will include pH, conductivity, temperature, and dissolved oxygen.

Laboratory Methods: All samples of macroinvertebrates will be processed and identified as per MDNR-FSS-209, Taxonomic Levels for Macroinvertebrate Identification. Turbidity samples will be analyzed at the MDNR biological laboratory

Data Recording and Analyses: Macroinvertebrate data will be entered in a Microsoft Access database in accordance with 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 SMSBPP: Total Taxa (TT); Ephemeroptera, Plecoptera, Trichoptera Taxa (EPTT); Biotic Index (BI); and the Shannon Index (SI) will be calculated for each reach. Additional metrics, such as Quantitative Similarity Index for Taxa (QSI-T), or Percent Scrapers (PS) may be employed to discern differences in taxa between control and impacted stations.

Macroinvertebrate data will be analyzed in three specific ways. First, a longitudinal comparison between reaches upstream and downstream of various potential influences, e.g., Columbia landfill, Grindstone Creek, will be used. Longitudinal patterns will be illustrated using XY line graphs with stream location (river mile) on the X-axis and biological characteristics on the Y-axis. Secondly, Hinkson Creek stations upstream and downstream of the entrance of Grindstone Creek will be compared with the sampled reaches of Bonne Femme Creek. Data will be summarized and presented in bar graphs comparing means of the four standard metrics, and other biological parameters, between the three general areas. Finally, the data from Hinkson and Bonne Femme creeks will be compared to biological criteria from regional reference streams within the same watershed size classification. Biocriteria data from previous years and those taken in the fall 2001 and spring 2002 surveys will constitute the basis of the comparison.

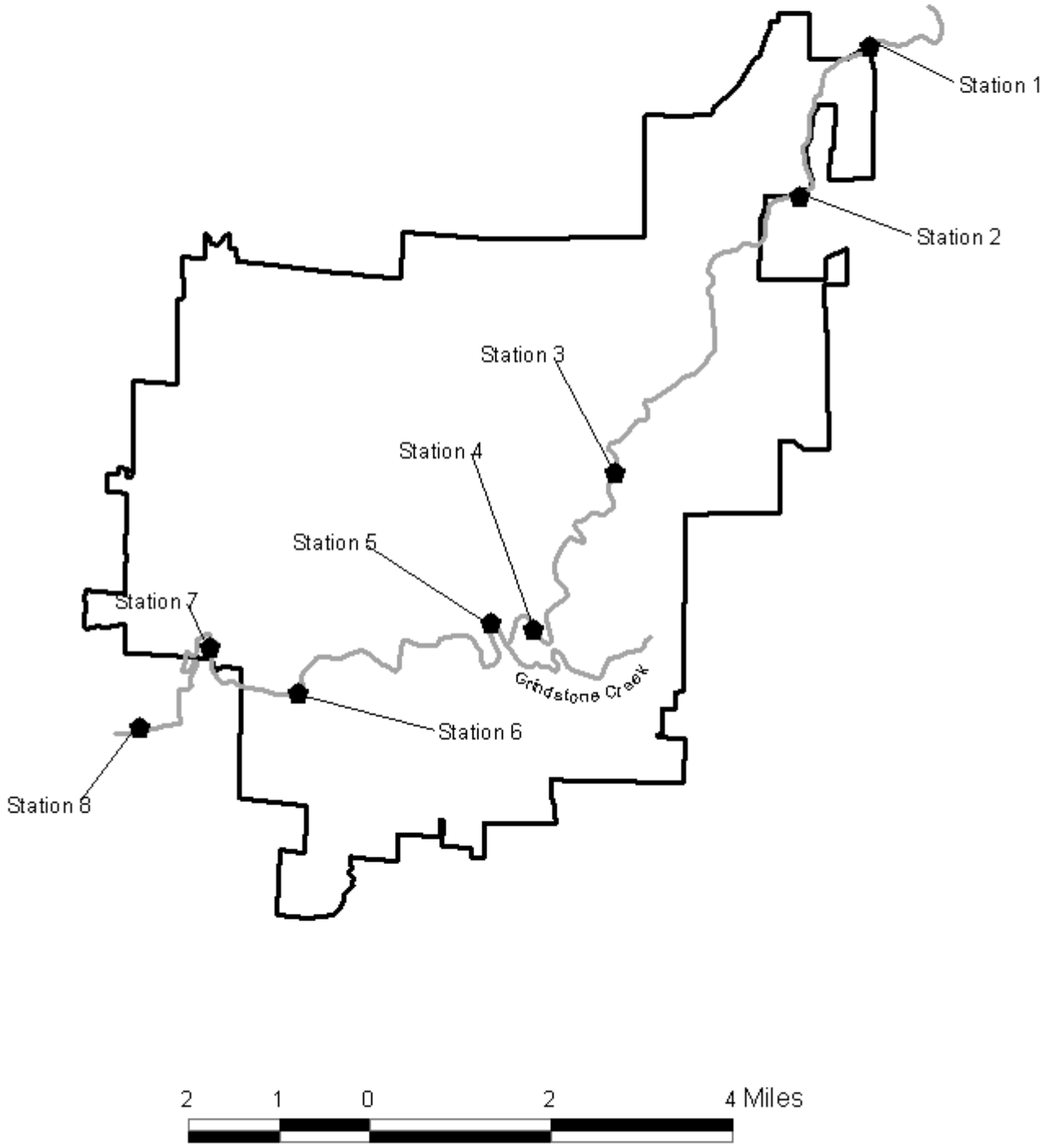
Ordination of macroinvertebrate data may be performed and regression analysis used to examine potential associations with water chemistry and habitat data. Habitat and water quality data will also be used to help interpret biological data.

Data Reporting: Results of the study will be summarized and interpreted in report format.

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

Attachments: Map of Hinkson Creek with sampling stations

Hinkson Creek Sampling Locations



Note: Sample stations in this diagram were labeled opposite from the conventional method used in the study. This oversight was corrected prior to data analysis and presentation.

Appendix B

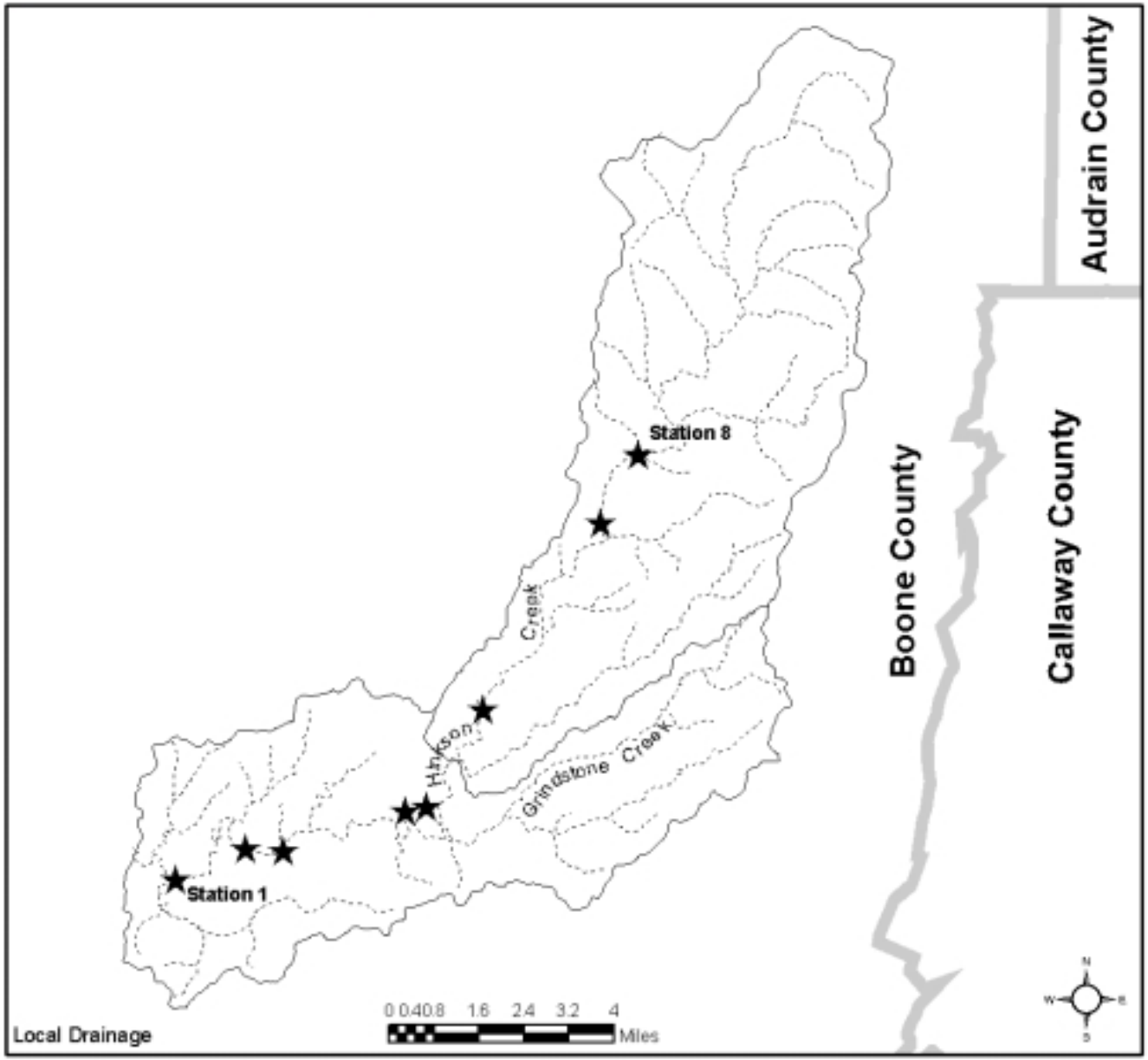
Maps

Hinkson Creek
Ozark/Moreau/Loutre EDU

&

Bonne Femme Creek
Ozark/Moreau/Loutre EDU

Hinkson Creek Study Site



Sampling Location

County Boundary

Local Drainage

Stream/River

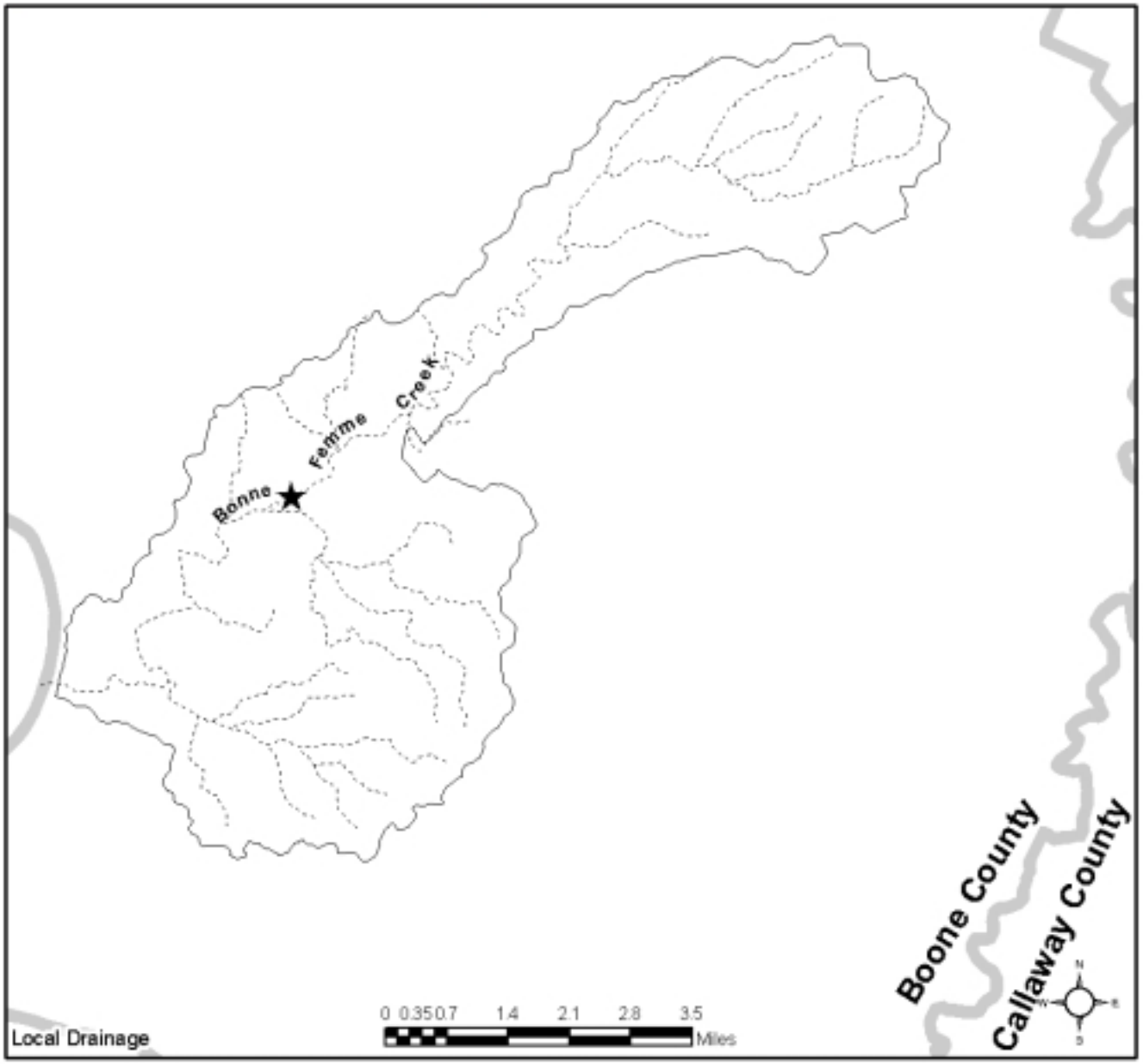
Local Drainage and Biologic Sampling Site Location

Ecolocial Drainage Unit (EDU) - An EDU is an area that contains a unique combination of habitats and organisms. Missouri is divided into 19 EDUs as shown in the inset map below. This site is located in the highlighted EDU.

Local Drainage - The local drainage area, also known as a 14 Digit Hydrologic Unit, is shown in the main map at left. This area is a portion of the local watershed. Missouri is split into over 1500 such units.

Ecological Drainage Unit

Bonne Femme Creek Study Site



Sampling Location

County Boundary

Local Drainage

Stream/River

Local Drainage and Biologic Sampling Site Location

Ecolocial Drainage Unit (EDU) - An EDU is an area that contains a unique combination of habitats and organisms. Missouri is divided into 19 EDUs as shown in the inset map below. This site is located in the highlighted EDU.

Local Drainage - The local drainage area, also known as a 14 Digit Hydrologic Unit, is shown in the main map at left. This area is a portion of the local watershed. Missouri is split into over 1500 such units.

Ecological Drainage Unit

Appendix C

Hinkson and Bonne Femme Creek Macroinvertebrate Bench Sheets

Hinkson Creek #1: Fall 2001

Taxa	CS	NF	RM
Branchiobdellida		10	6
Hyalella azteca			20
Berosus			7
Dubiraphia	1	17	67
Helichus lithophilus			1
Macronychus glabratus	1		
Scirtes			1
Stenelmis	37		5
Orconectes virilis		1	-99
Ablabesmyia	3	11	3
Anopheles			6
Ceratopogoninae		1	
Chironomus		6	
Cladotanytarsus		20	
Corynoneura		1	1
Cricotopus/Orthocladius	3		
Cryptochironomus		16	
Cryptotendipes		7	
Dicrotendipes		13	1
Glyptotendipes		7	5
Labrundinia		3	23
Natarsia			1
Parachironomus			3
Paracladopelma		1	
Parakiefferiella		2	
Paralauterborniella		11	
Paratanytarsus		1	3
Paratendipes		1	
Polypedilum convictum grp	39	2	
Polypedilum halterale grp		11	
Polypedilum illinoense grp	2	10	12
Polypedilum scalaenum grp	1	21	
Procladius		13	
Pseudochironomus		2	
Rheotanytarsus	141	3	4
Saetheria	2		
Stempellinella		3	
Tanytarsus	6	21	28
Thienemannimyia grp.	13		6
Acerpenna	51	1	4
Apobaetis		2	
Baetis	101	1	
Caenis latipennis		15	4
Heptageniidae	2		
Procloeon	2	8	1
Stenacron	2	7	4
Stenonema femoratum	4	2	
Tricorythodes	4		
Laevapex			7
Physa			1
Lumbriculidae			-99

Corydalus	1		
Argia	2	1	60
Calopteryx			2
Dromogomphus			-99
Enallagma			28
Gomphus		1	
Cheumatopsyche	268		3
Hydropsyche	15		
Hydroptila	6		
Oecetis		4	
Branchiura sowerbyi		3	1
Imm. Tub. w/ cap. Chaetae		2	1
Imm. Tub. w/o cap. Chaetae	4	12	7
Limnodrilus cervix			3

CS = Coarse Substrate Habitat

NF = Non-flow Habitat
RM = Rootmat Habitat
-99 = Present

Hinkson Creek #2: Fall 2001

Taxa	CS	NF	RM
Branchiobdellida		1	
Acarina		2	
Hyalella azteca	1		3
Erpobdellidae		1	
Dubiraphia		30	9
Enochrus	1		
Macronychus glabratus		2	
Peltodytes			1
Scirtes			1
Stenelmis	222	11	4
Orconectes		-99	
Ablabesmyia	12	10	3
Anopheles			21
Ceratopogoninae	4	2	
Chaoborus		3	
Chironomus	1	1	
Chrysops		1	
Cladopelma		1	
Cladotanytarsus	3	1	
Corynoneura		1	
Cryptochironomus	6		
Cryptotendipes	1	1	
Culex		1	1
Dicrotendipes	3	2	1
Ephydridae	1	1	
Forcipomyiinae	1	6	2
Glyptotendipes	1	1	1
Hemerodromia	2		
Hexatoma	1	-99	
Labrundinia		1	6
Larsia	2	1	1
Lipiniella		1	
Nilotanypus	2		
Ormosia		1	
Parachironomus		1	
Parakiefferiella		1	
Paralauterborniella		2	
Parametriocnemus	1		
Paratanytarsus			1
Paratendipes	3		
Polypedilum convictum grp	23		3
Polypedilum halterale grp	7	3	
Polypedilum illinoense grp	7	2	16
Polypedilum scalaenum grp	8	1	
Procladius		30	
Pseudosmittia			2
Rheotanytarsus	6		3
Stempellinella	1	1	
Tanytarsus	20	3	20
Thienemannimyia grp.	11	2	2
Tipula	1		2

undescribed Empididae		1	
Zavrelimyia		3	
Acerpenna	26	1	1
Baetis	16		
Caenis latipennis	13	74	2
Procloeon	2	8	21
Stenacron	11	12	3
Stenonema femoratum	20	61	
Tricorythodes	3		
Neoplea			1
Rhagovelia		1	
Rheumatobates			19
Steinovelia			3
Laevapex	3	7	1
Physa		1	
Lumbricidae	2		
Argia	1	4	3
Boyeria			1
Enallagma		1	11
Progomphus obscurus	-99		
Cheumatopsyche	82	2	
Branchiura sowerbyi	1	4	
Imm. Tub. w/ cap. Chaetae		2	
Imm. Tub. w/o cap. Chaetae	73	47	9
Limnodrilus cervix		1	
Limnodrilus hoffmeisteri	2	2	
Corbicula	8		
Sphaerium	4	3	1

CS = Coarse Substrate Habitat
NF = Non-flow Habitat
RM = Rootmat Habitat
-99 = Present

Hinkson Creek #3: Fall 2001

Taxa	CS	NF	RM
Branchiobdellida			10
Hyalella azteca			75
Berosus		2	4
Dubiraphia	2	25	124
Enochrus		1	
Helichus lithophilus	1		2
Laccobius		1	
Macronychus glabratus			1
Peltodytes			1
Scirtes			1
Stenelmis	69	1	1
Orconectes virilis	-99		1
Palaemonetes kadiakensis		-99	
Ablabesmyia	6	23	2
Anopheles			9
Ceratopogoninae		3	1
Chironomus	1	1	
Cladopelma		1	
Cladotanytarsus	4	11	
Corynoneura			2
Cricotopus/Orthocladius	7		
Cryptochironomus	9	9	
Cryptotendipes		10	
Culex			2
Dicrotendipes	4	8	1
Diptera		3	
Dolichopodidae		1	
Ephydridae		1	
Forcipomyiinae	1	1	
Glyptotendipes	3	3	9
Hemerodromia	3	1	
Hexatoma	-99		
Labrundinia		1	15
Nanocladius		2	2
Nilotanypus	2		
Ormosia		1	
Parachironomus	1		2
Paracladopelma		3	
Parakiefferiella		3	
Paralauterborniella		9	
Paratanytarsus			7
Polypedilum convictum grp	102		1
Polypedilum fallax grp		1	1
Polypedilum halterale grp	1	2	1
Polypedilum illinoense grp	13	1	6
Polypedilum scalaenum grp	6	2	1
Procladius		24	
Pseudochironomus		1	
Rheotanytarsus	16	1	1
Stempellinella		1	
Stictochironomus		1	

Tabanus	-99		
Tanytarsus	22	16	15
Thienemannimyia grp.	33	3	1
Acerpenna	28		2
Apobaetis		1	
Baetis	116		
Caenis latipennis	4	39	4
Callibaetis		1	
Hexagenia limbata		-99	
Procloeon		14	8
Stenacron	5	5	1
Stenonema femoratum	2	14	
Tricorythodes	2		
Rhagovelia	1		
Rheumatobates	1	1	3
Steinovelia			1
Trepobates			1
Noctuidae	1		
Ferrissia			3
Laevapex	2	2	6
Menetus			18
Physa			2
Corydalus	1		
Sialis		-99	
Argia	2	1	24
Basiaeschna janata			-99
Enallagma			77
Epitheca (Epicordulia)			-99
Hetaerina			1
Cheumatopsyche	206	2	3
Triaenodes			4
Aulodrilus		2	
Branchiura sowerbyi	1	6	1
Imm. Tub. w/ cap. Chaetae		1	2
Imm. Tub. w/o cap. Chaetae	9	33	12
Limnodrilus cervix		2	
Limnodrilus hoffmeisteri		3	
Corbicula	5	3	
Sphaerium	1	2	-99

CS = Coarse Substrate Habitat

NF = Non-flow Habitat
RM = Rootmat Habitat
-99 = Present

Hinkson Creek #4: Fall 2001

Taxa	CS	NF	RM
Branchiobdellida	1		
Gordiidae			1
Hyalella azteca		1	
Erpobdellidae	-99		
Berosus	1	4	
Dubiraphia	14	24	
Enochrus	2		
Helichus lithophilus	1		
Laccobius		1	
Scirtes			1
Stenelmis	234	2	
Orconectes virilis	1		
Ablabesmyia	5	12	
Anopheles			8
Apedilum		1	
Ceratopogoninae		4	
Cladotanytarsus		14	
Cricotopus/Orthocladius	12	2	
Cryptochironomus	2	6	
Cryptotendipes		1	
Dasyheleinae		1	
Dicrotendipes		5	
Dolichopodidae		1	
Forcipomyiinae	2	1	
Hemerodromia	2		
Hexatoma	1		
Labrundinia	1	2	
Ormosia		49	
Paracladopelma		2	
Parakiefferiella		2	
Paratendipes	6		
Polypedilum convictum grp	20		
Polypedilum halterale grp		2	
Polypedilum illinoense grp	6	2	4
Polypedilum scalaenum grp	7	1	
Procladius	2	5	
Pseudochironomus		1	
Rheotanytarsus	28		
Stempellinella		1	
Stictochironomus		5	
Tabanus	1		
Tanytarsus	10	4	
Thienemannimyia grp.	18	1	1
Tipula			1
Acerpenna	11		
Baetis	6		
Caenis latipennis	51	48	
Procloeon		24	
Stenacron	55		
Stenonema femoratum	26	8	
Tricorythodes	1		

Neoplea			2
Rheumatobates			1
Trepobates			3
Caecidotea	3		
Laevapex	19		
Physa	4	7	2
Pseudosuccinea			1
Corydalus	-99		
Argia	12		
Dromogomphus		1	
Enallagma			6
Hetaerina	2		
Nasiaeschna pentacantha			1
Progomphus obscurus		-99	
Cheumatopsyche	32		
Hydropsyche	1		
Hydroptila	6		
Planariidae	3		
Aulodrilus	1		
Branchiura sowerbyi	18	15	
Imm. Tub. w/ cap. Chaetae	1		
Imm. Tub. w/o cap. Chaetae	15	29	
Limnodrilus hoffmeisteri		4	
Corbicula	1	-99	
Sphaerium	9	8	1

CS = Coarse Substrate Habitat
NF = Non-flow Habitat
RM = Rootmat Habitat
-99 = Present

Hinkson Creek #5: Fall 2001

Taxa	CS	NF
Branchiobdellida	20	4
Acarina	1	6
Hyalella azteca		5
Berosus	1	2
Dubiraphia	1	17
Enochrus	4	
Helichus lithophilus	1	
Stenelmis	103	1
Orconectes virilis	1	-99
Ablabesmyia	2	13
Ceratopogoninae	7	5
Chironomus	7	
Cladopelma		1
Cladotanytarsus	1	28
Cricotopus/Orthocladius	6	
Cryptochironomus	1	2
Dicrotendipes	4	4
Forcipomyiinae	3	1
Larsia		1
Microtendipes		3
Nanocladius		3
Nilotanypus	2	
Ormosia		4
Paracladopelma		1
Parakiefferiella		22
Paratanytarsus	1	3
Paratendipes		1
Polypedilum convictum grp	68	2
Polypedilum halterale grp		3
Polypedilum illinoense grp	17	6
Polypedilum scalaenum grp	3	4
Procladius		2
Rheotanytarsus	23	1
Silvius	1	
Stempellinella		1
Stictochironomus		4
Tanytarsus	13	9
Thienemanniella	1	
Thienemannimyia grp.	13	1
Acerpenna	17	
Apobaetis		4
Baetis	17	
Caenis latipennis	32	44
Hexagenia limbata		1
Isonychia	1	
Procloeon	2	8
Stenacron	47	1
Stenonema femoratum	45	13
Tricorythodes	3	
Laevapex	8	2
Physa	11	4

Corydalus	3	
Argia	21	
Hetaerina	1	
Progomphus obscurus		1
Cheumatopsyche	31	
Chimarra	2	
Oecetis		2
Planariidae	3	
Branchiura sowerbyi	2	8
Imm. Tub. w/ cap. Chaetae		4
Imm. Tub. w/o cap. Chaetae	10	10
Corbicula	10	19
Sphaerium	6	

CS = Coarse Substrate Habitat
NF = Non-flow Habitat
-99 = Present

Hinkson Creek #6: Fall 2001

Taxa	CS	NF	RM
Branchiobdellida	21		1
Acarina	2		
Hyalella azteca		2	49
Berosus	5		5
Dubiraphia	2	45	19
Enochrus			2
Helichus lithophilus	1		
Laccobius	1		
Macronychus glabratus			-99
Scirtes			1
Stenelmis	191	2	6
Tropisternus			1
Orconectes virilis	-99	1	-99
Ablabesmyia	19	9	8
Anopheles			1
Ceratopogoninae	4	1	
Chironomus	2	2	1
Cricotopus bicinctus	5		1
Cricotopus/Orthocladius	15		1
Cryptochironomus	5	13	
Dicrotendipes	18	3	4
Diptera		1	
Dolichopodidae		2	
Ephydridae	1		1
Forcipomyiinae	5		
Glyptotendipes			3
Hemerodromia	2		
Labrundinia	1		1
Natarsia			2
Polypedilum illinoense grp	7	1	7
Polypedilum scalaenum grp	1	2	
Procladius		10	1
Tanypus		1	
Tanytarsus	20	4	6
Thienemannimyia grp.	26		7
Tipula			1
Acerpenna	3		
Baetis	5		
Caenis latipennis	112	140	27
Stenacron	17	2	1
Stenonema femoratum			3
Tricorythodes	1		
Microvelia			11
Ranatra nigra			1
Rhagovelia	1		
Rheumatobates			5
Steinovelia			1
Trepobates			18
Fossaria			1
Laevapex	5		
Menetus		1	2

Physa	53	1	27
Argia	19		1
Enallagma		2	42
Erythemis			
Libellula			1
Macromia		-99	
Nasiaeschna pentacantha			1
Cheumatopsyche	55	1	3
Oecetis			1
Triaenodes			1
Planariidae	1		1
Aulodrilus	8	1	1
Branchiura sowerbyi	8	2	3
Enchytraeidae			1
Imm. Tub. w/ cap. Chaetae		1	
Imm. Tub. w/o cap. Chaetae	14	11	2
Sphaerium	2	1	1

CS = Coarse Substrate Habitat
NF = Non-flow Habitat
RM = Rootmat Habitat
-99 = Present

Hinkson Creek #7: Fall 2001

Taxa	CS	NF	RM
Acarina		1	2
Hyalella azteca			94
Dubiraphia	4	13	53
Helichus lithophilus			1
Scirtes			15
Stenelmis	39		1
Orconectes virilis	-99		-99
Ablabesmyia	10	4	2
Anopheles			5
Ceratopogoninae		1	
Chaoborus	1		
Chironomus	17		
Cladotanytarsus		8	
Cricotopus/Orthocladius	3		1
Cryptochironomus	1	3	
Cryptotendipes		1	1
Dicrotendipes	5	1	
Diptera		1	
Glyptotendipes		2	4
Hexatoma	-99		-99
Labrundinia		1	6
Microtendipes	16		1
Natarsia	1		
Parachironomus			1
Paratanytarsus		2	5
Paratendipes	1		
Polypedilum halterale grp		1	
Polypedilum illinoense grp	6		1
Polypedilum scalaenum grp	1	1	
Procladius		6	
Rheotanytarsus	1		
Stempellina	1		
Stictochironomus		41	1
Tanypus		1	
Tanytarsus	6	3	2
Thienemannimyia grp.	1	1	1
Caenis latipennis	287	163	13
Choroterpes	1		
Hexagenia limbata		4	
Leptophlebiidae			6
Procloeon	4	2	
Stenacron	39	11	
Stenonema femoratum	100	27	2
Belostoma			-99
Trepobates	2		
Ferrissia		1	16
Laevapex	25	2	6
Menetus			7
Physa	5		25
Sialis		1	-99
Argia	3		5

Enallagma			21
Gomphidae		1	
Gomphus			-99
Macromia			-99
Nasiaeschna pentacantha			-99
Somatochlora			-99
Oecetis	2	1	
Triaenodes			13
Planariidae			3
Aulodrilus			1
Imm. Tub. w/o cap. Chaetae	3		
Sphaerium	1	1	2

CS = Coarse Substrate Habitat
NF = Non-flow Habitat
RM = Rootmat Habitat
-99 = Present

Hinkson Creek #8: Fall 2001

Taxa	CS	NF	RM
Branchiobdellida		5	
Acarina		3	2
Hyalella azteca			99
Berosus			3
Dubiraphia	8	16	25
Scirtes			34
Stenelmis	32		1
Orconectes virilis	1	1	-99
Ablabesmyia	41	12	5
Anopheles			2
Ceratopogoninae	7	13	
Chaoborus		20	
Chironomus	1	1	
Chrysops		2	
Cladotanytarsus	2	3	
Cryptochironomus	5	2	
Culex			1
Dicrotendipes	7	2	
Glyptotendipes		1	1
Hexatoma	3		
Labrundinia		3	4
Larsia		1	2
Parachironomus			3
Paracladopelma		1	
Paratanytarsus	2	1	10
Polypedilum halterale grp	2	2	
Polypedilum illinoense grp	1		15
Polypedilum scalaenum grp	4		
Procladius	1	4	
Pseudochironomus	2	3	
Rheotanytarsus			1
Stictochironomus	9	16	
Tanytarsus	4	5	1
Thienemanniella			2
Caenis latipennis	311	149	16
Hexagenia		1	
Leptophlebiidae			8
Procloeon	4		
Stenacron	53	3	
Stenonema femoratum	104	7	
Microvelia			1
Neoplea			5
Ranatra fusca			1
Trepobates			1
Laevapex	4	4	5
Menetus		1	3
Physa	1	1	9
Argia	1		2
Dromogomphus	2	2	
Enallagma			55
Erythemis	-99		

Libellula		1	
Macromia	-99	1	
Nasiaeschna pentacantha			1
Progomphus obscurus	3	1	
Helicopsyche	1		
Oecetis	3		
Polycentropus	1		
Triaenodes			11
Planariidae			3
Aulodrilus		3	
Imm. Tub. w/o cap. Chaetae		5	1
Sphaerium	4	9	

CS = Coarse Substrate Habitat
NF = Non-flow Habitat
RM = Rootmat Habitat
-99 = Present

Hinkson Creek #1: Spring 2002

Taxa	CS	NF	RM
Hyalella azteca		1	
Berosus		1	
Dubiraphia	2	5	6
Gyrinus			1
Stenelmis	34	2	
Palaemonetes kadiakensis			-99
Ablabesmyia		16	9
Ceratopogoninae	1	2	1
Chironomus	1	7	2
Cladotanytarsus		11	1
Corynoneura		4	5
Cricotopus bicinctus	14	1	27
Cricotopus/Orthocladius	272	13	48
Cryptochironomus	5	10	
Dicrotendipes	9	3	6
Diptera		2	
Glyptotendipes			4
Hemerodromia	1	1	
Hydrobaenus	35	36	36
Nanocladius		2	25
Natarsia	1		
Ormosia	2		
Parakiefferiella	1	1	1
Paralauterborniella		3	
Paratanytarsus	1	1	33
Paratendipes	1	2	
Phaenopsectra		4	4
Polypedilum convictum grp	19		
Polypedilum halterale grp	6	23	
Polypedilum illinoense grp			4
Polypedilum scalaenum grp	16	15	
Procladius		13	5
Rheotanytarsus	1		3
Simulium	2		
Stictochironomus	4	5	
Tanytarsus	25	12	30
Thienemanniella	7	3	35
Thienemannimyia grp.	43	11	39
Zavrelimyia		1	
Acerpenna	1		7
Caenis latipennis	4	14	3
Hexagenia limbata		1	
Leptophlebia			-99
Stenacron		-99	2
Stenonema femoratum	5	5	2
Caecidotea			1
Ferrissia			1
Physa			-99
Pseudosuccinea		1	
Argia		1	6
Basiaeschna janata			-99

Calopteryx			2
Enallagma			1
Progomphus obscurus	-99		
Cheumatopsyche	3	1	1
Hydroptila	2		
Oecetis			1
Rhyacophila	1		
Branchiura sowerbyi	-99	1	
Enchytraeidae		2	
Imm. Tub. w/ cap. Chaetae	1	2	
Imm. Tub. w/o cap. Chaetae	3	19	
Limnodrilus cervix		6	
Limnodrilus hoffmeisteri	3	14	5
Corbicula	1		
Sphaerium	1		

CS = Coarse Substrate Habitat
NF = Non-flow Habitat
RM = Rootmat Habitat
-99 = Present

Hinkson Creek #2: Spring 2002

Taxa	CS	NF	RM
Branchiobdellida			1
Acarina		1	
Crangonyx			1
Gammarus			1
Hyalella azteca			1
Erpobdellidae	1		1
Coleoptera		1	
Dubiraphia	2	8	2
Helichus lithophilus	1		
Oreodytes		2	1
Stenelmis	113	5	7
Orconectes virilis			-99
Ablabesmyia		6	2
Axarus		1	
Ceratopogoninae	1	3	
Chironomus	2	5	
Cladotanytarsus	2	4	
Corynoneura			2
Cricotopus bicinctus	26	1	61
Cricotopus/Orthocladius	205	8	33
Cryptochironomus	5	8	
Dicrotendipes	2	13	6
Glyptotendipes			5
Hydrobaenus	17	5	7
Microtendipes		1	
Nanocladius	1	1	51
Nilothauma			2
Parametriocnemus	1		
Paratanytarsus	1	1	20
Paratendipes	5	2	1
Phaenopsectra	4	1	5
Polypedilum convictum grp	11		
Polypedilum halterale grp	9	19	
Polypedilum illinoense grp			11
Polypedilum scalaenum grp	27	25	
Procladius	5	7	
Psectrocladius			1
Pseudochironomus		1	
Rheotanytarsus			1
Stempellinella		1	
Stenochironomus	1		
Stictochironomus	2	3	
Tanytarsus	16	6	25
Thienemanniella	17		13
Thienemannimyia grp.	36	3	31
Tipula			-99
Acerpenna	2		2
Caenis latipennis	17	16	8
Centroptilum			1
Stenacron	7		2
Stenonema femoratum	5	2	3

Belostoma		-99	2
Ancylidae		1	
Menetus			2
Physa		-99	
Argia	1	2	5
Basiaeschna janata			1
Calopteryx			3
Enallagma		3	24
Libellula		2	
Cheumatopsyche	5		1
Ptilostomis			-99
Branchiura sowerbyi		22	1
Imm. Tub. w/ cap. Chaetae		3	1
Imm. Tub. w/o cap. Chaetae	2	44	3
Limnodrilus cervix		6	3
Limnodrilus claparedianus	1		
Limnodrilus hoffmeisteri	4	9	3
Corbicula	14	3	
Sphaerium			1

CS = Coarse Substrate Habitat
NF = Non-flow Habitat
RM = Rootmat Habitat
-99 = Present

Hinkson Creek #3: Spring 2002

Taxa	CS	NF	RM
Acarina		1	
Hyalella azteca			6
Berosus	1	1	
Dineutus		-99	
Dubiraphia	1	4	6
Oreodytes		2	-99
Peltodytes		2	
Stenelmis	55	7	
Orconectes virilis		-99	-99
Ablabesmyia		8	6
Ceratopogoninae		17	
Chironomus		5	1
Cladotanytarsus		8	
Corynoneura	1	1	2
Cricotopus bicinctus	34	7	46
Cricotopus/Orthocladius	227	14	27
Cryptochironomus	14	15	1
Dicrotendipes	4	10	6
Glyptotendipes		2	15
Hemerodromia	1		
Hydrobaenus	8	11	5
Nanocladius		1	55
Natarsia	2		
Nilothauma	1	1	
Parakiefferiella		7	
Paralauterborniella		5	
Paraphaenocladius	1		
Paratanytarsus	2	3	20
Paratendipes	13	1	
Phaenopsectra		10	3
Polypedilum convictum grp	8		1
Polypedilum halterale grp	6	16	
Polypedilum illinoense grp	3	2	5
Polypedilum scalaenum grp	14	20	
Procladius		3	1
Rheotanytarsus	1	1	
Stempellinella	1	1	
Stenochironomus			1
Tanytarsus	30	20	29
Thienemanniella	17		2
Thienemannimyia grp.	56	9	35
Tipula		-99	
Acerpenna	2		
Caenis latipennis	5	41	5
Stenacron		4	4
Stenonema femoratum	9	3	1
Caecidotea			1
Ferrissia	2	1	1
Menetus			8
Physa	2		-99
Lumbricidae			-99

Argia		-99	2
Basiaeschna janata			-99
Calopteryx			-99
Dromogomphus		-99	
Enallagma		1	30
Libellula			-99
Macromia			-99
Cheumatopsyche	9	2	1
Ptilostomis			-99
Triaenodes			1
Aulodrilus		4	1
Branchiura sowerbyi		6	
Enchytraeidae	5	6	
Imm. Tub. w/ cap. Chaetae		8	
Imm. Tub. w/o cap. Chaetae	7	85	1
Limnodrilus cervix	1	3	
Limnodrilus hoffmeisteri	1	14	
Corbicula	10	5	
Sphaerium	2		1

CS = Coarse Substrate Habitat
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RM = Rootmat Habitat
-99 = Present

Hinkson Creek #4: Spring 2002

Taxa	CS	NF	RM
Branchiobdellida		1	
Acarina	1	1	1
Crangonyx			3
Hyalella azteca			4
Berosus		1	
Dubiraphia	1	17	4
Macronychus glabratus		1	
Oreodytes		1	1
Peltodytes		2	2
Stenelmis	17	10	2
Orconectes virilis		-99	
Ablabesmyia		1	3
Ceratopogoninae		2	
Chironomus	1	4	
Cladotanytarsus	2	38	
Corynoneura	3	2	6
Cricotopus bicinctus	84	25	75
Cricotopus/Orthocladius	380	41	81
Cryptochironomus		3	1
Dicrotendipes	3	3	3
Glyptotendipes			1
Hemerodromia		1	
Hydrobaenus	9	53	11
Nanocladius	4		8
Nilotanypus	1		
Nilothauma		1	
Ormosia		1	
Paracladopelma		1	
Parakiefferiella	2		1
Paratanytarsus		4	13
Paratendipes	1	6	
Phaenopsectra			9
Polypedilum convictum grp	1		
Polypedilum halterale grp		4	
Polypedilum illinoense grp		1	7
Polypedilum scalaenum grp	9	9	2
Procladius		1	
Pseudochironomus		2	
Rheocricotopus			1
Rheotanytarsus	11	1	3
Simulium	2		
Stictochironomus		2	
Sympotthastia	1		
Tanytarsus	25	30	19
Thienemanniella	11	2	7
Thienemannimyia grp.	26	12	17
Tipula		1	-99
Zavrelimyia		1	
Acerpenna	7		3
Caenis latipennis	11	31	7
Centroptilum			1

Stenacron	5	6	
Stenonema femoratum	5	13	
Caecidotea	1		1
Ferrissia	1		
Physa			1
Lumbricidae	-99		
Argia	2	1	1
Basiaeschna janata			-99
Enallagma		2	12
Hetaerina	1	1	
Libellula			1
Cheumatopsyche	1		
Hydroptila	4	1	
Pycnopsyche			-99
Planariidae			1
Branchiura sowerbyi	1	3	
Enchytraeidae	1		1
Imm. Tub. w/ cap. Chaetae		1	
Imm. Tub. w/o cap. Chaetae		22	6
Limnodrilus cervix		5	
Limnodrilus hoffmeisteri		1	
Sphaerium	-99		1

CS = Coarse Substrate Habitat
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-99 = Present

Hinkson Creek #5: Spring 2002

Taxa	CS	NF
Branchiobdellida		1
Dubiraphia	1	21
Oreodytes		1
Scirtes	1	
Stenelmis	29	4
Orconectes virilis		-99
Ablabesmyia		9
Ceratopogoninae		3
Chironomus		3
Cladotanytarsus		13
Corynoneura	2	5
Cricotopus bicinctus	105	31
Cricotopus/Orthocladius	307	61
Cryptochironomus		20
Dicrotendipes	3	
Diptera		1
Hemerodromia	1	1
Hydrobaenus	4	32
Nanocladius	9	4
Nilotanypus	1	
Parakiefferiella		2
Paralauterborniella		1
Parametriocnemus	2	
Paratanytarsus	3	2
Paratendipes	4	1
Polypedilum convictum grp	7	
Polypedilum halterale grp		2
Polypedilum illinoense grp	3	1
Polypedilum scalaenum grp	7	13
Procladius		3
Rheotanytarsus	7	
Simulium	3	
Stictochironomus	1	7
Tanytarsus	17	21
Thienemanniella	9	6
Thienemannimyia grp.	47	5
Tipula	-99	
Acerpenna	7	
Caenis latipennis	7	23
Stenacron	5	1
Stenonema femoratum	16	10
Ferrissia		1
Laevapex		1
Physa	4	
Argia		1
Enallagma		4
Piscicolidae	1	
Cheumatopsyche	4	1
Nyctiophylax		1
Rhyacophila	5	
Planariidae	5	

Branchiura sowerbyi		2
Enchytraeidae	1	1
Imm. Tub. w/ cap. Chaetae		5
Imm. Tub. w/o cap. Chaetae	1	13
Limnodrilus cervix		1
Corbicula	1	4
Sphaerium		3

CS = Coarse Substrate Habitat
NF = Non-flow Habitat
-99 = Present

Hinkson Creek #6: Spring 2002

Taxa	CS	NF	RM
Branchiobdellida			2
Crangonyx			1
Hyalella azteca			1
Berosus			1
Dubiraphia	2	1	1
Stenelmis	82	2	8
Orconectes virilis		1	-99
Ablabesmyia		1	2
Ceratopogoninae			1
Cladotanytarsus		4	2
Corynoneura	3		15
Cricotopus bicinctus	107	3	49
Cricotopus/Orthocladius	237	5	74
Cryptochironomus		1	
Demicryptochironomus		2	
Dicrotendipes	1		1
Diplocladius	1		1
Glyptotendipes			1
Hemerodromia	1		
Hydrobaenus	15	6	39
Limonia	2		
Microtendipes			2
Nanocladius	2		3
Paratanytarsus			8
Phaenopsectra			1
Polypedilum convictum grp	3	1	1
Polypedilum illinoense grp			4
Polypedilum scalaenum grp		1	2
Procladius			2
Simulium	21		
Stictochironomus		4	
Tabanus	2		
Tanytarsus	5		7
Thienemanniella	8		1
Thienemannimyia grp.	30		14
Tipula	-99		-99
Acerpenna	24		8
Caenis latipennis	2	5	21
Centroptilum			1
Stenonema femoratum	8	1	1
Noctuidae		-99	
Ferrissia	1	1	
Fossaria			2
Laevapex			1
Lymnaeidae	1		
Menetus		4	1
Physa	1	1	5
Argia	1		2
Basiaeschna janata			-99
Enallagma		1	10
Libellulidae			1

Cheumatopsyche	3	1	
Pycnopsyche	1		-99
Rhyacophila	3		
Planariidae	8		
Enchytraeidae	2		
Imm. Tub. w/ cap. Chaetae		1	
Imm. Tub. w/o cap. Chaetae	21	4	1
Limnodrilus cervix		2	1
Limnodrilus hoffmeisteri	1	2	2
Corbicula	1		-99
Pisidium			1
Sphaerium	4		

CS = Coarse Substrate Habitat
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-99 = Present

Hinkson Creek #7: Spring 2002

Taxa	CS	NF	RM
Branchiobdellida			1
Acarina			1
Crangonyx			1
Hyalella azteca		1	18
Dineutus			-99
Dubiraphia	2	1	5
Helichus lithophilus			1
Hydroporus			1
Oreodytes		3	
Peltodytes			1
Stenelmis	27	5	4
Orconectes virilis			2
Ablabesmyia	4		6
Axarus		1	
Ceratopogoninae	1	7	
Chironomus		2	
Cladotanytarsus	4	26	
Clinocera		1	
Corynoneura	22	9	18
Cricotopus bicinctus	4		9
Cricotopus/Orthocladius	283	11	83
Cryptochironomus	2	8	
Diamesa	1		
Dicrotendipes		2	3
Diplocladius	1		1
Eukiefferiella brevicalcar grp	19		3
Glyptotendipes			1
Hemerodromia	5		
Hexatoma	1		
Hydrobaenus	51	38	15
Labrundinia			1
Microtendipes		2	
Nanocladius			8
Natarsia			1
Ormosia		1	
Parakiefferiella	1		
Parametriocnemus	1		1
Paratanytarsus	2		13
Paratendipes	16	2	
Phaenopsectra			4
Polypedilum convictum grp	10		1
Polypedilum halterale grp		8	
Polypedilum illinoense grp	1		7
Polypedilum scalaenum grp	13	2	
Procladius		3	
Rheotanytarsus			1
Simulium	8		1
Stictochironomus		46	
Tabanus	-99		-99
Tanytarsus	14	15	12
Thienemanniella	6		4

Thienemannimyia grp.	21	4	12
Tipula	1		
Acerpenna	10		1
Caenis latipennis	29	78	45
Centroptilum			4
Leptophlebia			2
Stenacron	2	2	
Stenonema femoratum	10	3	4
Fossaria			1
Laevapex			1
Physa	-99		2
Calopteryx			-99
Enallagma		1	3
Libellula		1	
Nasiaeschna pentacantha			1
Isoperla	3		
Leuctridae	3		
Perlesta	8		
Strophopteryx	1		
Cheumatopsyche	4		1
Chimarra	1		
Helicopsyche	2		
Polycentropus		1	
Pycnopsyche			-99
Rhyacophila	5		3
Triaenodes			1
Enchytraeidae	1		1
Imm. Tub. w/o cap. Chaetae	3	13	
Limnodrilus hoffmeisteri	1	1	
Sphaerium	6	6	

CS = Coarse Substrate Habitat
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-99 = Present

Hinkson Creek #8: Spring 2002

Taxa	CS	NF	RM
Acarina	1	6	
Hyalella azteca	1		49
Dineutus			2
Dubiraphia		1	9
Helichus lithophilus			1
Oreodytes		2	1
Peltodytes		1	
Stenelmis	144	4	
Orconectes virilis	-99	-99	1
Ablabesmyia		1	1
Ceratopogoninae		4	
Chironomus		3	
Cladotanytarsus		17	
Corynoneura	9	1	7
Cricotopus bicinctus		2	
Cricotopus/Orthocladius	219	18	55
Cryptochironomus		1	
Dicrotendipes	1	7	4
Diplocladius	2		
Eukiefferiella claripennis grp	5		
Glyptotendipes	1		4
Hexatoma	2		
Hydrobaenus	31	38	42
Microtendipes		9	3
Nanocladius	1		2
Ormosia	1		
Paramerina			1
Parametriocnemus	1		
Paratanytarsus	4	2	3
Paratendipes	5	2	
Phaenopsectra	1		2
Polypedilum convictum grp	2		
Polypedilum halterale grp		1	
Polypedilum illinoense grp		1	1
Polypedilum scalaenum grp	5	2	
Procladius		1	
Pseudochironomus	1	1	
Simulium	13		
Stictochironomus	3	25	2
Tabanus	-99		
Tanytarsus	6	19	1
Thienemanniella	3		
Thienemannimyia grp.	16	1	4
Tipula	-99		
Tipulidae		1	
Tvetenia	1		
Acerpenna	7	1	5
Caenis latipennis	19	84	52
Centroptilum	1		3
Hexagenia limbata		2	
Leptophlebia			2

Stenacron	12	1	1
Stenonema femoratum	27	3	1
Ranatra fusca			1
Ferrissia	1	3	3
Fossaria	3	1	4
Menetus	1		
Physa	1	2	23
Basiaeschna janata			-99
Dromogomphus			-99
Enallagma		1	5
Libellula			1
Libellulidae		-99	
Progomphus obscurus		1	
Isoperla	1		
Leuctridae	1		
Perlesta	7		
Cheumatopsyche	2	1	
Polycentropus		1	
Ptilostomis			-99
Pycnopsyche			-99
Rhyacophila	10		1
Imm. Tub. w/ cap. Chaetae		1	
Imm. Tub. w/o cap. Chaetae	5	4	4
Limnodrilus cervix		1	
Limnodrilus claparedianus			1
Limnodrilus hoffmeisteri	2	4	
Sphaerium	2		5

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-99 = Present

Bonne Femme Creek #1: Fall 2001

Taxa	CS	NF	RM
Branchiobdellida			4
Acarina	4	14	2
Hyalella azteca		7	58
Dubiraphia		18	21
Enochrus	2		
Helichus	1		
Scirtes			16
Stenelmis	131	1	3
Orconectes virilis	-99	-99	-99
Palaemonetes kadiakensis			-99
Ablabesmyia	7	4	4
Anopheles			1
Ceratopogoninae	2	1	3
Chaoborus		20	
Chironomus	27	36	10
Cryptochironomus	1	2	
Dasyheleinae	1		
Dicrotendipes	5		7
Forcipomyiinae	13		
Glyptotendipes	1	3	26
Hemerodromia	3		
Hexatoma	6		
Kiefferulus			5
Labrundinia		1	7
Microtendipes	16		
Natarsia	3	2	3
Parachironomus			16
Paratanytarsus	1	3	25
Paratendipes	88	3	4
Phaenopsectra			6
Polypedilum convictum grp	28		1
Polypedilum illinoense grp	3		4
Polypedilum scalaenum grp	8	1	1
Procladius	2	8	3
Rheotanytarsus	23		
Stempellinella		1	
Stictochironomus		8	
Tabanus	-99		
Tanypus		4	1
Tanytarsus	24	4	14
Thienemannimyia grp.	24	1	5
Tribelos			2
undescribed Empididae	1		
Acerpenna	2		
Caenis latipennis	15	83	11
Callibaetis		3	
Procloeon		1	
Stenacron	27	5	
Stenonema femoratum	8	10	3
Tricorythodes			2
Belostoma			-99

Mesovelia			1
Neoplea			1
Veliidae	1		
Ancylidae	14		3
Menetus	1		2
Physa	8		4
Lumbriculidae	1		
Sialis	-99	1	
Sisyra			1
Argia	5	1	6
Basiaeschna janata			1
Dromogomphus			1
Enallagma			4
Nasiaeschna pentacantha			1
Glossiphoniidae	-99		
Cheumatopsyche	11		
Chimarra	19		
Nyctiophylax			3
Oecetis			1
Oxyethira		1	
Triaenodes			1
Planariidae	3		2
Branchiura sowerbyi	16	3	
Imm. Tub. w/ cap. Chaetae	11	10	
Imm. Tub. w/o cap. Chaetae	57	96	
Limnodrilus cervix		8	
Limnodrilus hoffmeisteri		2	
Sphaerium	2	1	

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-99 = Present

Bonne Femme #2: Fall 2001

Taxa	CS	NF	RM
Branchiobdellida	1		1
Acarina	2	19	1
Hyalella azteca		2	45
Erpobdellidae			2
Dubiraphia		23	35
Helichus basalis	2		1
Hydrochus	1		
Scirtes			11
Stenelmis	120		1
Orconectes virilis	2	-99	3
Palaemonetes kadiakensis			6
Ablabesmyia	4	22	5
Ceratopogoninae	4	7	2
Chaoborus		2	
Chironomus	14	12	
Chrysops	-99		
Cladotanytarsus	1	5	1
Corynoneura		1	5
Cricotopus/Orthocladius	2		
Cryptochironomus	9	5	
Dicrotendipes	3	2	2
Dixella			4
Endochironomus			3
Forcipomyiinae	4		
Glyptotendipes		1	17
Hemerodromia	10		
Hexatoma	1		
Labrundinia		2	16
Microtendipes	2		
Natarsia	2	1	2
Nilotanypus	1		
Parachironomus			9
Paralauterborniella	1		
Paratanytarsus			10
Paratendipes	35	6	2
Phaenopsectra			1
Polypedilum convictum grp	64	1	1
Polypedilum halterale grp	1	1	
Polypedilum illinoense grp	6	1	9
Polypedilum scalaenum grp	14	1	
Procladius	3	10	
Pseudochironomus		1	
Rheotanytarsus	3		
Stempellinella		2	
Stenochironomus		1	2
Stictochironomus		2	
Stratiomys	-99		
Tanypus		1	
Tanytarsus	16	7	10
Thienemannimyia grp.	49		
undescribed Empididae	1		

Caenis latipennis	42	50	5
Callibaetis		2	4
Hexagenia limbata		3	
Procloeon	2	6	
Stenacron	27	8	3
Stenonema femoratum	6	20	2
Corixidae	1	3	
Neoplea			1
Pelocoris			-99
Veliidae	1		
Ancylidae	11		3
Helisoma	-99		
Menetus			7
Planorbella			1
Argia	5		3
Basiaeschna janata			-99
Dromogomphus		-99	1
Enallagma		1	51
Gomphidae		4	
Macromia		1	1
Cheumatopsyche	11		
Chimarra	5		
Limnephilidae			-99
Oecetis		2	1
Triaenodes			5
Planariidae	72		3
Aulodrilus	7	15	
Branchiura sowerbyi	7	11	
Imm. Tub. w/ cap. Chaetae		7	
Imm. Tub. w/o cap. Chaetae	43	64	
Sphaerium	2		2

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Bonne Femme Creek #1: Spring 2002

Taxa	CS	NF	RM
Gordiidae	1		
Acarina	1	10	
Crangonyx	18	2	3
Hyalella azteca		1	39
Berosus		1	
Dineutus			12
Dubiraphia	1		2
Enochrus	1		
Gyrinus			1
Peltodytes		1	4
Stenelmis	35	9	1
Orconectes virilis			1
Ablabesmyia		13	1
Chironomus		10	
Cladotanytarsus	1	14	1
Clinocera	1		
Corynoneura	10	11	5
Cricotopus bicinctus	2		1
Cricotopus/Orthocladius	226	19	115
Cryptochironomus		5	1
Dicrotendipes		3	7
Eukiefferiella	5	1	
Glyptotendipes		2	3
Hexatoma	1	1	
Hydrobaenus	9	33	28
Labrundinia			1
Microtendipes	1	8	
Nanocladius			1
Natarsia		3	
Orthocladius (Euorthocladius)	3		
Parakiefferiella	1	1	
Parametriocnemus	6		
Paratanytarsus			16
Paratendipes	1	19	1
Phaenopsectra		1	5
Polypedilum convictum grp	10		
Polypedilum illinoense grp	1	2	
Polypedilum scalaenum grp	4	7	
Procladius		3	
Prosimulium	1		
Pseudochironomus		2	
Rheocricotopus	4		
Rheotanytarsus	1		
Simulium	7		
Stempellinella		1	
Stictochironomus		16	
Tabanus	1		
Tanytarsus	10	35	8
Thienemanniella	10		2
Thienemannimyia grp.	14	4	10
Tipula	1		

Tvetenia	1		
Acerpenna	7		
Caenis latipennis	16	24	8
Centroptilum			1
Leptophlebia			-99
Stenacron	20	1	1
Stenonema femoratum	28	15	2
Tricorythodes	1		
Caecidotea	17	9	
Fossaria		1	1
Menetus		2	
Physa		2	2
Sialis		-99	
Basiaeschna janata			1
Enallagma			6
Libellulidae		1	
Nasiaeschna pentacantha			1
Allocapnia	1		
Amphinemura	1		
Isoperla	133		
Perlesta	5		
Perlinella drymo			-99
Chimarra	5		
Pycnopsyche			1
Rhyacophila	5		
Enchytraeidae	1	3	
Imm. Tub. w/ cap. Chaetae		5	
Imm. Tub. w/o cap. Chaetae		36	2
Limnodrilus cervix		1	
Limnodrilus claparedianus		2	
Limnodrilus hoffmeisteri		3	1
Sphaerium	1		

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Bonne Femme Creek #2: Spring 2002

Taxa	CS	NF	RM
Branchiobdellida			3
Gordiidae	-99		
Acarina	1	10	3
Crangonyx	1	-99	5
Hyalella azteca			34
Dubiraphia		3	4
Stenelmis	83	5	5
Orconectes virilis			1
Palaemonetes kadiakensis			-99
Ablabesmyia	1	10	3
Ceratopogoninae			1
Chironomus		4	1
Cladotanytarsus	3	8	1
Clinocera	4	1	
Clinotanypus			1
Corynoneura	5	5	19
Cricotopus bicinctus			2
Cricotopus/Orthocladius	206	35	196
Cryptochironomus		16	
Cryptotendipes		2	
Dicrotendipes		3	7
Eukiefferiella brevicalcar grp	6		
Glyptotendipes		1	5
Hexatoma	1	1	
Hydrobaenus	1	24	27
Labrundinia		1	1
Microtendipes		3	1
Nanocladius	2		7
Orthocladius (Euorthocladius)	2		
Parakiefferiella	1	2	2
Paratanytarsus		1	27
Paratendipes	2	11	4
Phaenopsectra		1	4
Polypedilum convictum grp	20		2
Polypedilum halterale grp		1	
Polypedilum illinoense grp	2		4
Polypedilum scalaenum grp	4	6	
Procladius		3	
Rheocricotopus	3		
Rheotanytarsus	4		2
Simulium	3		
Stempellinella		1	
Stictochironomus		24	
Tabanus	1		
Tanytarsus	7	31	19
Thienemanniella	6		
Thienemannimyia grp.	14	4	9
Acerpenna	5		
Caenis latipennis	5	16	12
Stenacron	12	4	
Stenonema femoratum	12	15	8

Caecidotea	2		
Ferrissia		1	
Menetus			2
Physa			-99
Sialis			-99
Argia		-99	1
Basiaeschna janata			-99
Enallagma			20
Isoperla	95		3
Perlesta	2		
Perlinella drymo			-99
Agrypnia			1
Cheumatopsyche	3		
Chimarra	7		
Hydroptilidae			1
Nyctiophylax			1
Oecetis			3
Polycentropus			1
Pycnopsyche		-99	-99
Rhyacophila	3		
Triaenodes			2
Planariidae	2		
Branchiura sowerbyi		1	
Enchytraeidae	1		
Imm. Tub. w/ cap. Chaetae		4	
Imm. Tub. w/o cap. Chaetae	3	33	1
Limnodrilus claparedianus		2	
Limnodrilus hoffmeisteri		3	
Pisidium		1	
Sphaerium	1		

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