Missouri Department of Natural Resources

Biological Assessment Report

Mineral Fork
Washington County, Missouri

2005-2006

Prepared for:
Missouri Department of Natural Resources
Division of Environmental Quality
Water Protection Program
Water Pollution Control Branch

Prepared by:
Missouri Department of Natural Resources
Field Services Division
Environmental Services Program
Water Quality Monitoring Section

TABLE OF CONTENTS

TABLES

FIGURES

ATTACHMENTS

1.0 Introduction

Mineral Fork occurs in eastern Missouri approximately 40 miles southwest of St. Louis. Mineral Fork and its tributaries are included in the Ozark/Meramec Ecological Drainage Unit (EDU; Figure 1). The Mineral Fork watershed is approximately 189 square miles or 120,960 acres (MDC 1997).

Mineral Fork headwaters, which include Fourche Renault Creek and Mine a Breton Creek, originate near Potosi, Missouri in Washington County (Figure 2). Fourche Renault is a class “C” stream that flows approximately two-and-a half miles from Missouri Highway 8 north to Sunnen Lake. Fourche Renault Creek is a class “P” stream from the Sunnen Lake Dam to its confluence with Mine a Breton Creek approximately three miles east of Troutt, Missouri. At that point, Fourche Renault Creek and Mine a Breton Creek become Mineral Fork. Mineral Fork is a class “P” stream that flows northeasterly for approximately eight miles to its confluence with Big River, approximately six miles southwest of DeSoto, Missouri in Jefferson County. Class C streams may cease flow during drought, while class P streams maintain permanent flow even during drought (MDNR 2005b).

Beneficial use designations for Mineral Fork include livestock and wildlife watering (**LWW**); protection of warm-water aquatic life and human health-fish consumption (**AQL**); cool-water fishery (**CLF**); and whole body contact (**WBC**), Category A. Cool water fisheries are waters in which naturally occurring water quality and habitat conditions allow for the maintenance of sensitive, high quality sport fish, such as smallmouth bass and rock bass (MDNR 2005b). Whole body contact, Category A, includes waters that are established by the property owner(s) as full and free public swimming areas and/or for other whole body contact recreation use(s) (MDNR 2005b).

Fourche Renault Creek has similar beneficial use designations such as LWW and AQL, with two exceptions. The stream is not a CLF and it is designated for WBC, Category B. Category B applies to waters designated for whole body contact recreation not contained within Category A (MDNR 2005b).

1.1 Justification

Barite strip mining began in the early 1970s in the Big River drainage, primarily Washington County, which includes the Mineral Fork watershed. The majority of the mining took place east of Missouri State Highway 185 and by 1978 over 20, 000 acres were affected (MDC 1997; USDA 1980). Most mining has ceased, but many mine tailings ponds, dams, and waste piles remain (MDC 1997).

The Mineral Fork biological assessment study was conducted at the request of the Missouri Department of Natural Resources (**MDNR**), Water Protection Program (**WPP**), Water Pollution Control Branch (**WPCB**). The Environmental Services Program (**ESP**), Water Quality Monitoring Section (**WQMS**), Aquatic Bioassessment Unit (**AQU**) coordinated and conducted the study.

1.2 Purpose

Determine if Mineral Fork is biologically impaired.

1.3 Objectives

1) Assess the stream habitat quality of Mineral Fork.

2) Assess the macroinvertebrate community integrity and water quality of Mineral Fork.

1.4 Tasks

1) Conduct a stream habitat assessment for Mineral Fork and compare results with Cub Creek (habitat control).

2) Conduct a biological assessment, including macroinvertebrate and water physicochemical collection and analyses.

3) Compare biological assessment results to wadeable/perennial stream biological criteria and perform metric comparison between stations.

4) Compare physicochemical water quality between stations, controls, and with Water Quality Standards (**WQS** - MDNR 2005b).

1.5 Null Hypotheses

Stream habitat will be similar between test stations and the control station.

Biological metrics and scores will be similar between stations and to wadeable/perennial stream biological criteria.

Physicochemical water quality will be similar at all stations and parameters will meet the criteria found in the Missouri WQS (MDNR 2005b).

2.0 Methods

Kenneth B. Lister (ESP), David Michaelson (ESP), and other members of the WQMS conducted this study. Randy Sarver (ESP) and Andy Austin of the Missouri Department of Conservation (**MDC**) assisted with this project.

2.1 Study Area and Station Descriptions

The study area included approximately 11 miles of Mineral Fork and Fourche Renault Creek combined. Cub Creek #1, Washington County, was used as the stream habitat assessment control (Table 1; Figure 1). Three stations were allocated for the Mineral Fork study (Table 1; Figure 2). Fourche Renault Creek station #3 upstream, or west, of MO 185 was considered to be the upstream control. Mineral Fork station #2 was located due north of the Pea Ridge Conservation Access (**CA**). Mineral Fork station #1 was upstream from the Kingston CA. The Cub Creek #1 habitat control station was

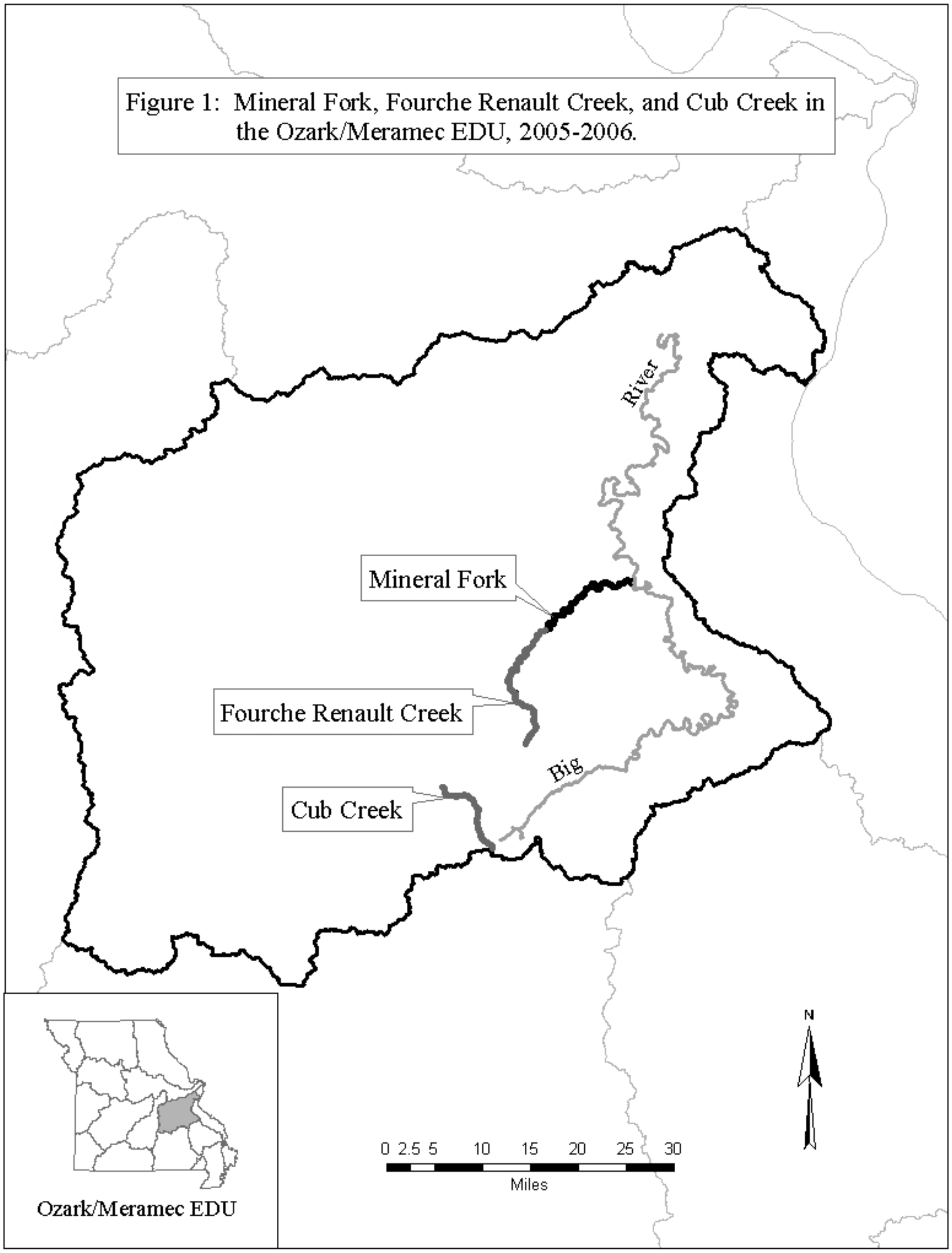
Figure 1: Mineral Fork, Fourche Renault Creek, and Cub Creek in the Ozark/Meramec EDU, 2005-2006.
River
Mineral Fork
Fourche Renault Creek
Big
Cub Creek
Ozark/Meramec EDU
0 2.5 5 10 15 20 25 30
Miles
N

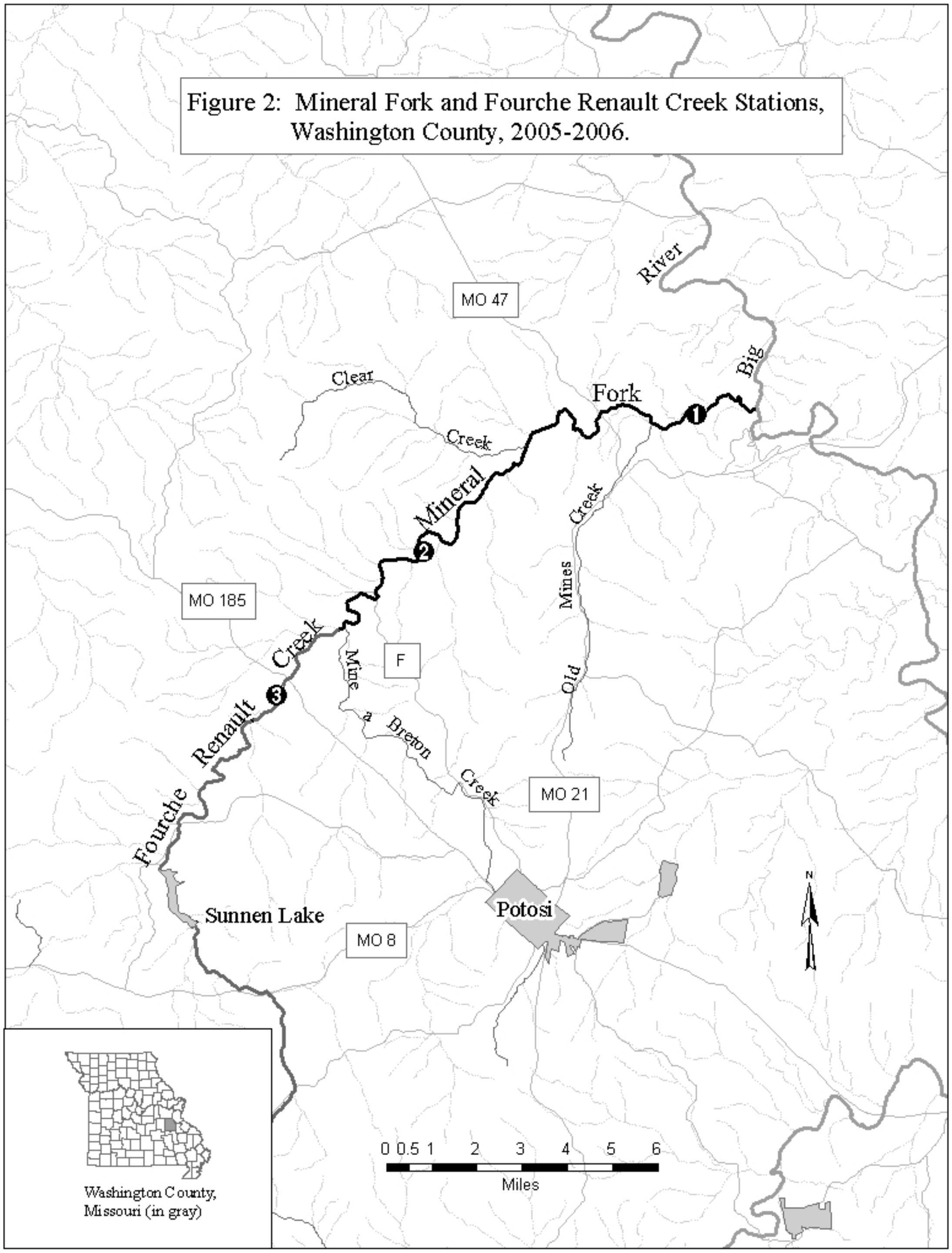
Figure 2: Mineral Fork and Fourche Renault Creek Stations, Washington County, 2005-2006.
MO 47
Big River
Clear Creek
Fork
Mineral
Mines Creek
Old
MO 185
Creek
F
Mine a Breton Creek
Renault
Fourche
MO 21
Sunnen Lake
Potosi
MO 8
N
0 0.5 1 2 3 4 5 6
Miles
Washington County, Missouri (in gray)

downstream of Bethel Church near Courtois, Missouri and approximately 1.0 mile upstream from the confluence with Courtois Creek.

Table 1
Location and Descriptive Information for Mineral Fork, Fourche Renault Creek, and Cub Creek Stations, Washington County, 2005-2006

Stream-Station Number	Location-Section, Township, Range; Latitude Longitude	Description	County
Fourche Renault Creek #3	NW ¼ sec. 24, T. 38 N., R. 01 E. Lat. 38^0 00’ 44.7” Long. -90^0 52’ 40.8	Upstream MO 185, Control	Washington
Mineral Fork #2	NE ¼ sec. 04, T. 38 N., R. 02 E. Lat. 38^0 03’ 09.8” Long. -90^0 49’ 13.3”	North of Pea Ridge CA	Washington
Mineral Fork #1	NW ¼ sec. 21, T. 39 N., R. 03 E. Lat. 38^0 05’ 48.0” Long. -90^0 42’ 38.0”	Approx. ⅓ mile north of Kingston CA parking lot; Upstream	Washington
Cub Creek #1 (SHAPP Control)	SE ¼ sec. 32, T. 36 N., R. 01 W. Lat. 37^0 47’ 03.9” Long. -91^0 03’ 16.8”	Downstream Bethel Church	Washington

2.1.1 Ecological Drainage Unit

Mineral Fork and Fourche Renault Creek are within the Ozark/Meramec Ecological Drainage Unit (EDU; Figure 1). Ecological Drainage Units are delineated drainage units that are described by physiographic and major riverine components. Within an EDU, similar size streams are expected to contain similar aquatic communities and stream habitat conditions. Comparisons of biological and physicochemical results should then be appropriate between test streams and similar size reference streams within the same EDU.

2.1.2 Land Use Description

Land cover of the Ozark/Meramec EDU was compared to land cover near the Mineral Fork stations, at the scale of 14-digit Hydrological Units (**HUC-14**; Table 2). Percent land cover data were derived from Thematic Mapper (TM) satellite data collected between 2000 and 2004 and interpreted by the Missouri Resource Assessment Partnership (**MoRAP**).

Land cover at Mineral Fork and Fourche Renault Creek was dominated by approximately 80 to 90 percent forest, followed by approximately 10 percent grassland, and a very low percentage of urban areas (Table 2). The percent land cover at Mineral Fork and Fourche Renault Creek was similar to Cub Creek (stream habitat assessment control), but slightly different from the Ozark/Meramec EDU. The EDU contains slightly more grassland overall (27 percent) than urban areas, which is as much as 20 percent less than the individual stations. Since test and control stations are similar, land use should not be a factor that would interfere with interpretation of results between streams. Strip mining is evident in the test area, however, the percentage of strip mining is not categorized using this methodology.

Table 2
Percent Land Cover in the Mineral Fork, Fourche Renault Creek, and Cub Creek Stations, Washington County, and the Ozark/Meramec EDU

Stations	HUC-14	Urban	Crops	Grass	Forest	Swamp	Open-water
Fourche Renault Creek #3	07140104040001	0	0	13	83	0	1
Mineral Fork #2, #1	07140104040003	1	0	10	83	2	1
Cub Creek #1 (SHAPP only)	07140102040002	0	0	7	92	0	0
Ozark/Meramec EDU	NA	4	1	27	62	--	--

2.2 Study Timing

Sampling took place in the fall of 2005 and spring of 2006. Fall macroinvertebrate and water samples were collected September 27, 2005. Spring samples were collected at Mineral Fork #1 on March 28, 2006. Mineral Fork #2 and Fourche Renault #3 were sampled March 29, 2006. Stream habitat assessments were conducted at #3, #2, and #1 on April 4, 2006 and compared to Cub Creek (SHAPP control) results from an assessment on March 24, 2004.

2.3 Stream Habitat Assessment Project Procedure

The standardized Stream Habitat Assessment Project Procedure (**SHAPP**) was followed as described for Riffle/Pool prevalent streams (MDNR 2003d). The integrity of an aquatic biological community is dependent on the quality of the stream habitat. Stream habitat was scored based on the quality or quantity of certain parameters. SHAPP scores were compared between test and control stations. If the SHAPP score at a test station is ≥75% of the mean SHAPP control scores, the stream habitat at the test station is considered to be comparable to the reference (control) stream. Cub Creek, Washington County, was used as the SHAPP control (Table 1; Figure 1). Stream habitat assessment scores were compared between test stations (longitudinally) and with the SHAPP control score.

2.4 Biological Assessment

Sampling was conducted as described in the MDNR Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (**SMSBPP,** MDNR 2003c). A biological assessment consists of macroinvertebrate community and physicochemical water evaluation.

2.4.1 Macroinvertebrate Sampling and Analyses

As identified in the SMSBPP (2003c), macroinvertebrates were sampled from three specific habitats. These target habitats are based on stream type (MDNR 2003c). Mineral Fork and Fourche Renault are considered riffle/pool streams in which coarse substrate (**CS**) or riffle, non-flowing water over depositional substrate (**NF**), and rootmat (**RM**) habitats were sampled. Macroinvertebrates were subsampled according to the SMSBPP and identified to specific taxonomic levels (MNDR 2005a) in order to calculate metrics in a standardized fashion (MDNR 2003c; MDNR 2005a).

Macroinvertebrate community data were analyzed using three strategies. Macroinvertebrate Stream Condition Index (**MSCI**) scores, individual biological criteria metrics, and dominant macroinvertebrate families (**DMF**) were examined and compared from upstream to downstream.

The first strategy is based on the MSCI. A Stream Condition Index is a qualitative measurement of a stream's aquatic biological integrity (Rabeni et al. 1997). The MSCI was further refined using additional information from biological reference streams (**BIOREF**s) within each EDU in Biological Criteria for Perennial/Wadeable Streams (MDNR 2002; MDNR 2003c). A station's MSCI score is a compilation of rank scores that are assigned to the primary biological criteria metrics. The four primary biological criteria metrics are: 1) Taxa Richness (**TR**); 2) Ephemeroptera/Plecoptera/Trichoptera Taxa (**EPTT**); 3) Biotic Index (**BI**); and 4) Shannon Diversity Index (**SDI**). An individual metric score is compared to its BIOREF scoring range (MSCI Scoring Table, Tables 4 and 5) and a rank score (5, 3, or 1) is assigned to that metric (Tables 4 and 5). This is repeated for each of the four metrics and rank scores are compiled to complete the MSCI score. Biological integrity is based on the MSCI scores and is interpreted as follows: 20-16 = full biological support; 14-10 = partial biological support; and 8-4 = non-support of the biological community (MDNR 2003c). MSCI scores were grouped by season and compared between stations.

A second measure to evaluate the macroinvertebrate community examined individual biological criteria metrics. Each individual metric was compared to the BIOREF scoring range to identify the level of integrity for each station. Variations in the metrics may help identify how a community is effected and potentially identify a source of impairment.

The third biological analysis was an evaluation of the taxa that occur in each station. Dominant macroinvertebrate families (**DMF**) are compiled as a percentage of the total number of individuals in a sample. Dominance by certain families may allude to the quality of the station and help identify a type and source of impairment. A taxa list is attached as Appendix A and is grouped by season and station.

2.4.2 Physicochemical Water Sampling and Analyses

Physicochemical water samples were handled according to the appropriate MDNR, ESP Standard Operating Procedure (**SOP**) and/or Project Procedure (**PP**) for sampling and analyzing physicochemical water samples. Results for physicochemical water parameters were examined by season and station.

Fall 2005 and spring 2006 physicochemical water parameters were either sampled by field measurements or grab samples. Water was sampled according to the SOP MDNR-FSS-001 Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations (MDNR 2003b). All samples were kept on ice during transport to ESP.

Water samples were either measured *in-situ* or analyzed at the Environmental Services Program laboratory. Temperature (C^o), pH, conductivity (uS), dissolved oxygen (mg/L), and discharge (cubic feet per second-**cfs**) were measured in the field. Turbidity (NTU) was measured and recorded in the WQMS biology laboratory. The ESP, Chemical Analysis Section (**CAS**) in Jefferson City, Missouri conducted analyses for ammonia-nitrogen (mg/L), nitrate+nitrite-nitrogen (mg/L), total nitrogen (mg/L), chloride (mg/L), and total phosphorus (mg/L). Samples for dissolved metals (barium, cadmium, calcium, cobalt, copper, lead, magnesium, nickel, and zinc) were filtered in the field and analyzed by the CAS.

Physicochemical water parameters were compared between stations from upstream to downstream, as well as with Missouri's WQS (MDNR 2005b). Interpretation of acceptable limits in the WQS may be dependent on a stream's classification and its beneficial-use designation (MDNR 2005b). Mineral Fork is a class "P" stream, with designated uses for LWW, AQL, CLF, and WBC-category A. Furthermore, acceptable limits for some parameters, such as dissolved metals, may be dependent on the rate of exposure. These exposure or toxicity limits are based on the lethality of a toxicant given long-term exposure (chronic toxicity, **c**) or short-term exposure (acute toxicity, **a**).

2.4.3 Discharge

Stream flow was measured using a Marsh-McBirney Flowmate™ flow meter at each station. Velocity and depth measurements were recorded at each station according to SOP MDNR-WQMS-113 Flow Measurement in Open Channels (MDNR 2003a).

2.5 Quality Control

Quality control measures were conducted in accordance with MDNR SOPs and Project Procedures.

3.0 Results

Results are shown for the stream habitat assessment and biological assessments. Components of the biological assessment are grouped by each sample season and by station.

3.1 Stream Habitat Assessment

All test station stream habitat assessment scores were comparable to the Cub Creek SHAPP control score (Table 3). Scores were well above the guidance of >75 percent for test stations to be considered comparable to the control (MDNR 2003d). The Cub Creek SHAPP control score was 142. Fourche Renault Creek #3 scored 169, while Mineral Fork #2 scored 157, followed by #1 at 142. The lowest score was 100 percent of the SHAPP control.

Table 3
Stream Habitat Assessment Scores and Percentage Comparison for Mineral Fork, Fourche Renault Creek, and Cub Creek (SHAPP Control), Washington County

	Fourche Renault Creek #3	Mineral Fork #2	Mineral Fork #1	Cub Creek #1 (SHAPP Control)
SHAPP Scores	169	157	142	142
Percent of SHAPP Control	119	110	100	--

3.2 Biological Assessment

A biological assessment consists of macroinvertebrate community analyses and physicochemical water parameter analyses. Results are grouped by season and station. Trends or exceptional results are in bold type.

3.2.1 Macroinvertebrate Community Analyses

Evaluation of the macroinvertebrate communities in Mineral Fork and Fourche Renault Creek involved application of the qualitative MSCI, individual metrics, and examination of dominant macroinvertebrate families. Results are grouped by season and station.

In the fall of 2005, all Mineral Fork and Fourche Renault Creek stations were assigned to the full biological support category (Table 4). Stations #3 and #2 had scores of 20, out of a possible 20. Station #1 had an MSCI score of 18. The BI contributed to the lower MSCI score at station #1 in the fall. The BI at station #1 was 5.78, while the optimum scoring range started at <5.78. A rank score of 3 was assigned to the BI.

In the spring of 2006, MSCI scores indicated that all stations were fully supporting the biological community (Table 5). Fourche Renault #3, Mineral Fork station #2, and Mineral Fork station #1 all scored 20 out of a possible 20. All individual metric scores were well within the optimum BIOREF scoring range (Table 5).

Table 4
Fall 2005 Biological Criteria (BIOREF) Metric Scores, Biological Support Category, and MSCI Scores for Mineral Fork and Fourche Renault Creek Stations, Washington County

Stream and Station Number	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Fourche Renault Creek #3	0503084	98	29	4.94	3.48	20	Full
Mineral Fork #2	0503083	82	26	5.38	3.29	20	Full
Mineral Fork #1	0503085	99	31	**5.78**	3.25	18	Full
BIOREF Score=5	--	>78	>21	<5.78	>3.08	20-16	Full
BIOREF Score=3	--	78-39	21-10	5.78-7.89	3.08-1.54	14-10	Partial
BIOREF Score=1	--	<39	<10	>7.89	<1.54	8-4	Non

MSCI Scoring Table (in light gray) developed from BIOREF streams (n=7). TR=taxa richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index

Table 5
Spring 2006 Biological Criteria (BIOREF) Metric Scores, Biological Support Category, and MSCI Scores for Mineral Fork and Fourche Renault Creek Stations, Washington County

Stream and Station Number	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Fourche Renault Creek #3	0602653	101	32	4.23	3.79	20	Full
Mineral Fork #2	0602652	119	33	4.76	3.79	20	Full
Mineral Fork #1	0602651	95	35	5.02	3.47	20	Full
BIOREF Score=5	--	>92	>29	<5.80	>3.32	20-16	Full
BIOREF Score=3	--	92-46	29-14	5.80-7.90	3.32-1.66	14-10	Partial
BIOREF Score=1	--	<46	<14	>7.90	<1.66	8-4	Non

MSCI Scoring Table (in light gray) developed from BIOREF streams (n=6). TR=taxa richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index

The dominant families were very consistent from upstream to downstream with a few exceptions (Table 6). Pleurocerid snails comprised 17.8 percent of the sample and Psephenid beetles 4.5 percent at station #3, but were not dominant downstream. Other intolerant taxa such as heptageniids and isonychiid mayflies were consistently dominant from upstream to downstream. Representatives of all dominant families were found at all stations. Overall, a very diverse group of taxa was found in the fall at the test stations (Appendix A).

Table 6
Dominant Macroinvertebrate Families (DMF) as a Percentage of the Total Number of Individuals per Station, Fall 2005

Station Sample Number	Fourche Renault Creek #3 0503084	Mineral Fork #2 0503083	Mineral Fork #1 0503085
Pleuroceridae	17.8	--	--
Elmidae	14.9	10.5	10.1
Chironomidae	10.3	11.9	19.9
Heptageniidae	8.1	10.7	4.7
Leptohyphidae	5.0	21.2	22.9
Isonychiidae	4.7	5.1	2.8
Psephenidae	4.5	--	--
Caenidae	4.3	3.8	13.9
Arachnoidea	--	8.4	4.7
Hydropsychidae	--	7.5	3.9

The dominant macroinvertebrate taxa were relatively consistent from upstream to downstream in the spring (Table 7). Generally intolerant taxa such as Ephemerellidae and Heptageniidae mayflies were among the dominant taxa at all stations. Perlidae stoneflies were among the dominant taxa at #3. Representatives of all dominant families were found at all stations. Overall, a very diverse group of taxa was found in the spring at the test stations (Appendix A).

Table 7
Dominant Macroinvertebrate Families (DMF) as a Percentage of the Total Number of Individuals per Station, Spring 2006

Station Sample Number	Fourche Renault Creek #3 0602653	Mineral Fork #2 0602652	Mineral Fork #1 0602651
Chironomidae	20.7	22.9	18.9
Ephemerellidae	17.3	15.5	15.5
Heptageniidae	11.4	5.3	9.9
Arachnoidea	6.9	--	3.7
Elmidae	5.9	12.3	7.1
Simuliidae	5.4	3.4	--
Caenidae	3.8	5.0	15.6
Perlidae	3.5	--	--
Leptohyphidae	--	7.5	8.4
Hydropsychidae	--	5.9	5.1

3.2.2 Physicochemical Water Analyses

Physicochemical water analyses identified interesting trends in the fall and spring samples. All of the parameters were within acceptable ranges for WQS (MDNR 2005b). Only trends from each season are highlighted.

In the fall, three parameters followed trends from upstream to downstream (Table 8). Discharge increased over three-fold from upstream to downstream. Chloride levels were observed in low concentrations at station #3, increased at station #2, then lowered again at station #1. Dissolved barium increased approximately three-fold from #3 to #1. None of the parameters were beyond WQS criteria (MDNR 2005b).

Table 8
Physicochemical Water Parameters for Mineral Fork and
Fourche Renault Creek Stations, Fall 2005

Station Parameter/Date	Fourche Renault Creek #3 9-27-06	Mineral Fork #2 9-27-05	Mineral Fork #1 9-27-05
Sample Number	0505650	0505649	0505651
pH (Units)	8.1	8.1	8.3
Temperature (C^0)	20.0	20.0	22.5
Conductivity (uS)	374	456	456
Dissolved O_2	7.60	7.63	8.45
Discharge (cfs)	**22.1**	**47.2**	**70.6**
Turbidity (NTUs)	1.0	1.0	1.0
Nitrate+Nitrite-N	0.11	0.21	0.09
Total Nitrogen	0.24	0.31	0.20
Ammonia-N	<0.03	<0.03	<0.03
Chloride	**3.02**	**6.09**	**5.70**
Total Phosphorus	0.77	0.78	0.79
Hardness as $CaCO_3$	205	249	245
Barium (ug/L) – Dissolved	**184**	**432**	**553**
Cadmium (ug/L) – Dissolved	<0.25	<0.25	<0.25
Calcium	39.9	48.6	46.8
Cobalt (ug/L) – Dissolved	<1.00	<1.00	<1.00
Copper (ug/L) – Dissolved	0.46	0.51	2.92
Lead (ug/L) – Dissolved	<0.25	<0.25	<0.25
Magnesium – Dissolved	25.5	30.9	31.1
Nickel – (ug/L) Dissolved	0.53	0.60	0.66
Zinc – (ug/L) Dissolved	1.12	3.09	4.39

(Units mg/L unless otherwise noted; **Bold** = trend)

In the spring of 2006, three water quality parameters followed interesting trends from upstream to downstream (Table 9). None of the parameters exceeded WQS (MDNR 2005b). Discharge increased by approximately two-fold from upstream to downstream. Chloride increased slightly from #3 to #2 and then decreased at station #1. Dissolved barium increased approximately three-fold from upstream to downstream.

Table 9
Physicochemical Water Parameters for Mineral Fork and
Fourche Renault Creek Stations, Spring 2006

Station Parameter/Date	Fourche Renault Creek #3 3-29-06	Mineral Fork #2 3-29-06	Mineral Fork #1 3-28-06
Sample Number	0603200	0603199	0603198
pH (Units)	8.2	8.3	8.3
Temperature (C^0)	10.0	8.5	9.0
Conductivity (uS)	258	334	351
Dissolved O_2	12.6	12.7	11.6
Discharge (cfs)	**45.7**	**79.1**	**135**
Turbidity (NTUs)	4.22	2.37	2.01
Nitrate+Nitrite-N	0.13	0.18	0.18
Total Nitrogen	0.32	0.35	0.30
Ammonia-N	<0.03	0.03	<0.03
Chloride	**2.45**	**4.35**	**3.85**
Total Phosphorus	0.01	0.01	<0.01
Hardness as $CaCO_3$	147	192	199
Barium (ug/L) – Dissolved	**115**	**260**	**349**
Cadmium (ug/L) – Dissolved	<0.25	<0.25	<0.25
Calcium	29.9	38.7	40.0
Cobalt (ug/L) – Dissolved	<1.00	<1.00	<1.00
Copper (ug/L) – Dissolved	0.85	0.55	0.81
Lead (ug/L) – Dissolved	<0.25	<0.25	<0.25
Magnesium – Dissolved	17.6	23.1	24.1
Nickel (ug/L) – Dissolved	0.45	0.31	<0.25
Zinc (ug/L) – Dissolved	2.68	3.21	2.86

(Units mg/L unless otherwise noted; **Bold** = trend)

4.0 Discussion

Stream habitat assessments, general observations, macroinvertebrate community metrics, and macroinvertebrate community compositions are examined. Interesting trends for physicochemical water parameter results are discussed.

4.1 Stream Habitat Assessment

Using the MDNR Stream Habitat Assessment Project Procedure (MDNR 2003d), Mineral Fork and Fourche Renault Creek stream habitat was found to have high quality stream habitat when compared to Cub Creek, Washington County (SHAPP control). The scores declined slightly from upstream to downstream but remained above or equal to the control.

However, general observations showed altered stream morphology in several places. Station #3 had significant point bar formation approximately 100 yards upstream. A very large, approximately 200 yard long by 60 yard long, point bar was present in station #2. Station #1 had a very large vegetated gravel bar and sections of heavy stream bank erosion. High water prior to our visit in the spring apparently removed large sections of two high banks at #1. Localized low quality riparian area, scarce bank vegetation, and homes or cabins built within 20 yards of #1 were possible contributors to the bank erosion. Best management practices should be applied wherever possible.

4.2 Macroinvertebrate Community Analyses

The macroinvertebrate community analyses illustrated that all three stations were comparable to biological criteria and longitudinally comparable during both sample seasons. All stations were fully supporting the stream community during both seasons.

However, the BI was elevated at #1 during the fall and may indicate that organic influences were present in concentrations that would slightly alter the macroinvertebrate composition toward a more tolerant community. Such influences are present at station #1, with several houses or cabins located within a few yards of the stream. It is also possible that the margin of error in the BI scoring is too broad to definitively identify a problem.

The taxa dominance and presence from upstream to downstream was relatively similar during both seasons. The few taxa that were dominant at some stations and not in others were present at all stations. Dominant macroinvertebrate families and the diversity of individual taxa identified a high quality macroinvertebrate community in the fall and spring. Slight changes in the macroinvertebrate community composition from upstream to downstream were consistent between seasons and may have been a function of increased stream size.

4.3 Physicochemical Water Analyses

Physicochemical water parameters were generally unremarkable with a few exceptions (Tables 8 and 9). None of the parameters examined in this project exceeded or were outside WQS (MDNR 2005b) in the fall or spring. However, several parameters followed trends from upstream to downstream or between seasons. Discharge increased from upstream to downstream. Chloride and dissolved barium followed trends of interest that generally identify potential influences.

4.3.1 Discharge

Discharge increased three-fold from upstream to downstream during both seasons. This was due in part to three larger tributaries of Mineral Fork. Mine a Breton Creek enters upstream of #2; Clear Creek and Old Mines Creek are upstream of station #1. All drain large portions of the watershed (Figure 2).

4.3.2 Chloride

Chloride concentrations increased two-fold from station #3 to station #2 and lowered again at #1 during both seasons. This suggests that a continuous source of chloride was present in the stream between #3 and #2. Mine a Breton Creek enters Mineral Fork in that area (Figure 2) and could be the source for chloride. Mine a Breton Creek drains the Potosi Wastewater Treatment Facility #1 which could be a contributor of the low level concentrations. Local non-point sources are present as well. Chloride is also a constituent of metals associated mining. Strip mines are found in the Mine a Breton Creek drainage. Organic sources and strip mines should be identified and monitored. The water quality of Mine a Breton Creek should be assessed and monitored.

4.3.3 Dissolved Barium

Physicochemical water analyses indicated that there was a continuous presence of dissolved barium at the two downstream stations. Fourche Renault Creek #3, upstream of Missouri Highway 185, served as an upstream control to Mineral Fork. Fourche Renault Creek dissolved barium concentrations upstream of Missouri 185, were similar to background levels that were found in Big River upstream of the Mill Creek confluence (MDNR 2004). Either strip mining has not occurred in the upper Fourche Renault Creek watershed or runoff from tailings was controlled during our visit. Barium concentrations increased over 100 percent between station #3 to station #2 and another 50 percent between #2 and #1 during both seasons. This suggests that Mineral Fork downstream of Missouri 185 has continuous input of barium.

Mineral Fork tributaries may be associated with the dissolved barium loading (Figure 2). The increase in concentration between #3 and #2 suggests that Mine a Breton Creek may be one source of barium. The increase between #2 and #1 suggests that Clear Creek and/or Old Mines Creek may be other sources. The concentrations increased at both downstream stations, which suggests that all major tributaries may carry dissolved barium. Sources for the dissolved metals should be identified and monitored. Water quality should be assessed in Mine a Breton Creek, Clear Creek, and Old Mines Creek. Fine sediment influences in the watershed should be stabilized to reduce mine-related runoff from entering Mineral Fork. Fine sediment studies should be conducted on tributaries of Mineral Fork.

5.0 Conclusion

The objectives and tasks were achieved in this study. Using data and analyses from the macroinvertebrate based biological assessment and stream habitat assessments, Mineral Fork, Washington County was not impaired during the 2005-2006 sample periods.

The stream habitat was of high quality when compared to the SHAPP control, but general observations identified localized stream bank problems at station #1. The macroinvertebrate community integrity was good due to the diverse and intolerant assemblage present. Water quality was within WQS, with a continuous low level of chloride and a relatively high level of dissolved barium concentrations downstream of station #3.

The hypotheses were examined. 1) Stream habitat was similar between test stations and the control station; 2) Biological metrics were similar to wadeable/perennial stream biological criteria, as well as between stations; 3) Physicochemical water quality was similar relative to the WQS, however, chloride and barium increased at downstream stations. All parameters were within accepted levels of Missouri Water Quality Standards (MDNR 2005b) during the study.

6.0 Recommendations

1) Maintain stream and riparian habitat according to best management practices.

2) Conduct biological assessments on Mineral Fork tributaries, including Mine a Breton Creek, Clear Creek, and Old Mines Creek.

3) Identify and monitor sources of barium and other mine-related metals.

4) Monitor organic indicators and dissolved metals concentrations at all stations, especially high flows.

5) Stabilize fine sediment sources in the watershed (i.e. tailings ponds, dams, and strip pit areas).

6) Conduct fine sediment studies on Mineral Fork tributaries.

7.0 Literature Cited

Missouri Department of Natural Resources. 2002. Biological Criteria for Wadeable/Perennial Streams of Missouri. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 32 pp.

Missouri Department of Natural Resources. 2003a. Flow measurements in open channels. Water Quality Monitoring Section-113. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 9 pp.

Missouri Department of Natural Resources. 2003b. Required/recommended containers, volumes, preservatives, holding times, and special sampling considerations. Field Services Section-001. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 25 pp.

Missouri Department of Natural Resources. 2003c. Semi-quantitative macroinvertebrate stream bioassessment project procedure. Field Services Section-030. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 24 pp.

Missouri Department of Natural Resources. 2003d. Stream habitat assessment project procedure. Field Services Section-032. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 40 pp.

Missouri Department of Natural Resources. 2004. Biological and fine sediment study. Big River (lower): Irondale to Washington State Park St. Francois, Washington, and Jefferson Counties, Missouri, 2002-2003. Missouri Department of Natural Resources, Field Services Division, Environmental Services Program, Water Quality Monitoring Section. 40 pp. + app.

Missouri Department of Conservation. 1997. Big River basin inventory and management plan. Missouri Department of Conservation, Fisheries Division. 106 pp.

United State Department of Agriculture (USDA). 1980. Soil Conservation Service. Natural resources inventory database. Columbia, Missouri.

Missouri Department of Natural Resources. 2005a. Taxonomic levels for macroinvertebrate identifications. Water Quality Monitoring Section-209. Environmental Services Program, P.O. Box 176, Jefferson City, Missouri. 30 pp.

Missouri Department of Natural Resources. 2005b. Title 10. Rules of Department of Natural Resources Division 20-Clean Water Commission, Chapter 7-Water Quality. 10 CSR 20-7.031 Water Quality Standards. pp. 10-136.

Rabeni, C.F., R.J. Sarver, N. Wang, G.S. Wallace, M. Weiland, and J.T. Peterson. 1997. Biological criteria for streams of Missouri. Missouri Cooperative Fish and Wildlife Research Unit, University of Missouri-Columbia, Columbia, Missouri. 261 pp.

Submitted by: ___________________________________

Kenneth B. Lister
Environmental Specialist
Water Quality Monitoring Section
Environmental Services Program

Date: ___________________________________

Approved by: ___________________________________

Alan Reinkemeyer
Director
Environmental Services Program

AR:klt

c: John Ford, WPP
Gary Gaines, SERO

Appendix A

Invertebrate Database Bench Sheet Report
Mineral Fork and Fourche Renault Creek
Washington County
Grouped by Station for Fall 2005 and Spring 2006

Aquid Invertebrate Database Bench Sheet Report
Fourche Renault Ck [0503084], Station #3, Sample Date: 9/27/2005 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	5	15	3
AMPHIPODA			
Hyalella azteca		5	26
COLEOPTERA			
Ancyronyx variegatus			1
Berosus		11	
Dubiraphia		75	43
Ectopria nervosa	8	3	1
Macronychus glabratus		1	1
Microcylloepus pusillus	1		14
Optioservus sandersoni	29	2	1
Psephenus herricki	34	11	
Scirtidae	1		
Stenelmis	3	18	
DECAPODA			
Cambarus maculatus	-99		
Orconectes harrisonii			-99
Orconectes hylas			-99
Orconectes luteus	-99		
Orconectes medius	-99		
DIPTERA			
Ablabesmyia		2	1
Atherix	2		
Ceratopogoninae		1	
Chironomus		1	
Cricotopus bicinctus			7
Cricotopus/Orthocladius	6	2	30
Diptera			1
Forcipomyiinae			1
Hemerodromia			3
Labrundinia		6	5
Nanocladius		2	2
Parakiefferiella		6	1
Parametriocnemus	1		
Paratanytarsus		1	4
Polypedilum convictum grp			1
Polypedilum illinoense grp	1	1	3
Rheocricotopus	1		1
Rheotanytarsus	3	2	13
Simulium	2	1	
Stempellinella	1		
Stenochironomus			1
Stictochironomus		1	
Sublettea	1		
Tabanus	-99		
Tanytarsus	1	3	15

Aquid Invertebrate Database Bench Sheet Report
Fourche Renault Ck [0503084], Station #3, Sample Date: 9/27/2005 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Thienemanniella		1	1
Tipula	-99		
Tribelos		2	
EPHEMEROPTERA			
Baetis	39		3
Baetiscidae		1	1
Caenis anceps	10	1	1
Caenis latipennis		34	9
Centroptilum		2	4
Choroterpes		1	
Ephemerella			2
Eurylophella	2	4	
Heptageniidae	35		2
Isonychia bicolor	59		1
Leptophlebiidae		4	
Procloeon		1	
Pseudocloeon			4
Stenacron	7	4	1
Stenonema bednariki	1		
Stenonema femoratum	1	4	
Stenonema mediopunctatum	44		
Stenonema pulchellum	4		
Tricorythodes	39	6	19
HEMIPTERA			
Belostoma			1
LIMNOPHILA			
Ancylidae	1	8	1
Gyraulus			1
Helisoma	-99	7	1
Lymnaeidae			1
Menetus			1
Physella	1	1	
LUMBRICINA			
Lumbricina	-99	3	
MEGALOPTERA			
Corydalus	-99		
MESOGASTROPODA			
Elimia	218	3	4
ODONATA			
Argia	7	10	1
Boyeria			-99
Calopteryx			2
Dromogomphus		1	
Enallagma			1
Gomphidae		10	
Hetaerina			4
Macromia			1
Stylogomphus albistylus	27		
PLECOPTERA			

Aquid Invertebrate Database Bench Sheet Report
Fourche Renault Ck [0503084], Station #3, Sample Date: 9/27/2005 12:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Acroneuria	-99		
Neoperla		1	
TRICHOPTERA			
Cheumatopsyche	1	1	9
Chimarra			1
Helicopsyche	3		1
Hydroptilidae	1	1	
Oecetis		1	14
Oxyethira			4
Polycentropus		1	1
Triaenodes		7	12
TRICLADIDA			
Planariidae	15	26	1
TUBIFICIDA			
Branchiura sowerbyi		8	
Tubificidae		2	
VENEROIDEA			
Corbicula	-99		
Sphaeriidae	2	27	2

Aquid Invertebrate Database Bench Sheet Report
Mineral Fk [0503083], Station #2, Sample Date: 9/27/2005 10:45:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	11	77	27
AMPHIPODA			
Hyalella azteca		1	28
Stygobromus		1	
COLEOPTERA			
Ancyronyx variegatus			1
Berosus	-99	6	1
Dubiraphia		38	11
Ectopria nervosa	1		
Hydroporus		1	
Macronychus glabratus			6
Optioservus sandersoni	42	18	1
Psephenus herricki	1	15	1
Stenelmis	11	13	3
DECAPODA			
Orconectes luteus			1
DIPTERA			
Ablabesmyia		5	3
Atherix	1		
Ceratopogoninae			1
Chironomus		4	
Corynoneura			1
Cricotopus bicinctus	1		
Cricotopus/Orthocladius	6	4	17
Cryptotendipes		1	1
Dicrotendipes			2
Hemerodromia	1		
Labrundinia		3	34
Microtendipes	1		
Nanocladius			1
Parakiefferiella		2	1
Paratanytarsus		1	20
Polypedilum illinoense grp			22
Procladius		1	
Rheotanytarsus	1		4
Simulium	3		
Tanytarsus	2	10	11
Thienemannimyia grp.	3		
Tipula	1		
Tribelos			1
EPHEMEROPTERA			
Baetis	38		3
Barbaetis	1		
Caenis anceps	5		
Caenis latipennis	13	19	15
Centroptilum			2
Ephemerellidae	4		

Aquid Invertebrate Database Bench Sheet Report
Mineral Fk [0503083], Station #2, Sample Date: 9/27/2005 10:45:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Heptageniidae	52		1
Isonychia bicolor	70		
Leptophlebiidae		2	
Leucrocuta	2		
Stenonema mediopunctatum	81		
Stenonema pulchellum	10		
Tricorythodes	273	2	15
ISOPODA			
Caecidotea (Blind & Unpigmented)		1	
LIMNOPHILA			
Ancylidae	1	1	2
Gyraulus	2	2	2
Helisoma		9	1
Lymnaeidae		1	1
Menetus	-99	9	
Physella	1	7	5
LUMBRICINA			
Lumbricina	1	4	
MEGALOPTERA			
Corydalus	2		1
MESOGASTROPODA			
Elimia	-99	3	1
ODONATA			
Argia	2	1	7
Calopteryx			1
Enallagma			8
Hetaerina			1
Ophiogomphus	2		
PLECOPTERA			
Acroneuria	-99		
Pteronarcys pictetii	1		
TRICHOPTERA			
Ceratopsyche morosa grp	12		6
Cheumatopsyche	50		9
Chimarra	4		
Helicopsyche	1		
Hydropsyche			26
Hydroptila			2
Nectopsyche		1	
Oecetis	2		2
Oxyethira	2		1
Polycentropodidae			1
Triaenodes			4
TRICLADIDA			
Planariidae	6	2	
TUBIFICIDA			
Branchiura sowerbyi		2	
Tubificidae		9	2
VENEROIDEA			

Aquid Invertebrate Database Bench Sheet Report
Mineral Fk [0503083], Station #2, Sample Date: 9/27/2005 10:45:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Corbicula	-99	2	-99
Sphaeriidae	5	40	

Aquid Invertebrate Database Bench Sheet Report
Mineral Fk [0503085], Station #1, Sample Date: 9/27/2005 2:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	8	30	30
AMPHIPODA			
Hyalella azteca			32
Stygobromus		2	
COLEOPTERA			
Ancyronyx variegatus			1
Berosus		1	5
Dubiraphia		18	12
Ectopria nervosa	6	4	1
Enochrus			2
Macronychus glabratus			3
Microcylloepus pusillus			1
Optioservus sandersoni	8		
Psephenus herricki		-99	
Stenelmis	52	35	15
DECAPODA			
Orconectes luteus	-99		-99
DIPTERA			
Ablabesmyia		6	5
Ceratopogoninae			1
Chironomus		9	
Cladopelma		4	
Cladotanytarsus		12	
Corynoneura			2
Cricotopus bicinctus			1
Cricotopus/Orthocladius	18	1	23
Cryptochironomus		1	1
Cryptotendipes		1	
Dicrotendipes		1	
Forcipomyiinae			1
Hemerodromia		1	1
Labrundinia		1	29
Microtendipes		2	
Nanocladius			1
Parakiefferiella		4	3
Parametriocnemus		1	
Paratanytarsus			28
Phaenopsectra		1	
Polypedilum convictum grp	1	1	
Polypedilum halterale grp		1	
Polypedilum illinoense grp			9
Procladius		1	
Pseudochironomus	2	7	1
Rheocricotopus	1		
Rheotanytarsus	12		6
Simulium			1
Stempellinella		13	

Aquid Invertebrate Database Bench Sheet Report
Mineral Fk [0503085], Station #1, Sample Date: 9/27/2005 2:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Stenochironomus	1		2
Tabanus	-99		
Tanytarsus	16	12	39
Thienemanniella			2
Tribelos		1	
undescribed Empididae		1	1
EPHEMEROPTERA			
Acentrella		5	
Acerpenna		1	
Baetidae	1		
Baetis	2		
Baetisca lacustris		1	
Caenis anceps	14	15	
Caenis latipennis	17	127	26
Centroptilum			8
Eurylophella		1	
Heptageniidae	15	3	
Isonychia bicolor	40		
Leptophlebiidae		1	
Leucrocuta	2		
Procloeon		4	3
Stenacron		2	2
Stenonema bednariki	1		
Stenonema femoratum		7	
Stenonema mediopunctatum	22		
Stenonema pulchellum	11	1	1
Tricorythodes	314	3	9
LEPIDOPTERA			
Parapoynx			-99
LIMNOPHILA			
Ancylidae	2		3
Lymnaeidae		3	6
Physella		1	3
LUMBRICINA			
Lumbricina	2	-99	
MEGALOPTERA			
Corydalus	-99		
MESOGASTROPODA			
Elimia	11	2	-99
ODONATA			
Argia	4		5
Basiaeschna janata			1
Boyeria			2
Enallagma			7
Gomphidae		1	1
Hagenius brevistylus	1		-99
Hetaerina	-99		7
Ophiogomphus	-99		
PLECOPTERA			

Aquid Invertebrate Database Bench Sheet Report
Mineral Fk [0503085], Station #1, Sample Date: 9/27/2005 2:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Perlidae		1	
Pteronarcys pictetii	-99		
TRICHOPTERA			
Ceratopsyche morosa grp	3		
Cheumatopsyche	53		
Chimarra	2		
Helicopsyche	35	1	
Nectopsyche	2	3	3
Oecetis	2		7
Oxyethira			1
Polycentropodidae			1
Setodes	1		
TRICLADIDA			
Planariidae			1
TUBIFICIDA			
Tubificidae		5	
VENEROIDEA			
Corbicula	-99	1	
Sphaeriidae	16	7	

Aquid Invertebrate Database Bench Sheet Report
Fourche Renault Ck [0602653], Station #3, Sample Date: 3/29/2006 12:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	78	7	4
AMPHIPODA			
Hyalella azteca		1	2
COLEOPTERA			
Dubiraphia	4	10	11
Ectopria nervosa		1	
Hydroporus		1	
Lutrochus	1		
Macronychus glabratus			3
Microcylloepus pusillus			1
Optioservus sandersoni	33	4	
Psephenus herricki	14	15	
Scirtidae			1
Stenelmis	7	2	1
DECAPODA			
Orconectes luteus	1	-99	-99
Orconectes punctimanus		1	2
DIPTERA			
Ablabesmyia		11	
Antocha	1		
Cardiocladius	5		
Ceratopogoninae		3	
Cladotanytarsus		1	
Clinocera	12	5	
Corynoneura		3	2
Cricotopus/Orthocladius	32	17	15
Dicrotendipes	1	3	
Djalmabatista		1	
Dolichopodidae			1
Eukiefferiella	9		1
Hemerodromia	7	2	1
Hydrobaenus	2	10	
Orthocladius (Euorthocladius)	2		
Parakiefferiella		23	
Parametriocnemus	2	2	
Paratanytarsus		7	5
Polypedilum convictum grp	9	1	1
Polypedilum scalaenum grp		2	10
Potthastia			1
Prosimulium	30		4
Rheocricotopus	10	1	2
Rheotanytarsus	2		6
Simulium	21	1	14
Stempellinella	1	3	1
Tabanus		-99	
Tanytarsus	17	23	
Thienemanniella		1	

Aquid Invertebrate Database Bench Sheet Report
Fourche Renault Ck [0602653], Station #3, Sample Date: 3/29/2006 12:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Thienemannimyia grp.	4	8	2
Tipula			-99
Tribelos		1	
Tvetenia	5		
Zavrelimyia		1	
EPHEMEROPTERA			
Acentrella	18		2
Baetisca lacustris			-99
Caenis anceps	5	5	
Caenis latipennis	7	20	12
Ephemerella invaria	38		5
Ephemerella needhami	30	1	97
Eurylophella bicolor	8	19	8
Eurylophella enoensis			16
Heptageniidae	29	1	2
Isonychia bicolor	18		1
Leptophlebia			1
Stenacron	1	2	1
Stenonema femoratum	6	10	
Stenonema mediopunctatum	68	9	3
Stenonema pulchellum	8	2	5
Tricorythodes	25	8	8
ISOPODA			
Caecidotea (Blind & Unpigmented)	1		
LEPIDOPTERA			
Petrophila	2		
LIMNOPHILA			
Ancylidae	1		
Gyraulus		1	
Menetus	1	1	
Physella			-99
LUMBRICINA			
Lumbricina	-99	5	
MEGALOPTERA			
Corydalus	1		
MESOGASTROPODA			
Elimia	8	4	6
ODONATA			
Argia	3	1	
Basiaeschna janata			-99
Boyeria			-99
Calopteryx			-99
Enallagma			1
Gomphidae	8	5	
Hagenius brevistylus			-99
PLECOPTERA			
Amphinemura	5	1	11
Leuctridae	6	6	
Perlesta	5		40

Aquid Invertebrate Database Bench Sheet Report
Fourche Renault Ck [0602653], Station #3, Sample Date: 3/29/2006 12:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Pteronarcys pictetii	12		3
TRICHOPTERA			
Agapetus	4		
Ceratopsyche morosa grp	1		
Cheumatopsyche	11		1
Chimarra	2		
Helicopsyche	1		
Hydroptila	12	2	5
Nectopsyche			1
Oxyethira			7
Polycentropodidae	2		
Polycentropus		1	
Pycnopsyche	-99	-99	4
Rhyacophila	2		
TRICLADIDA			
Planariidae	9		
TUBIFICIDA			
Enchytraeidae		1	
Tubificidae	2		
VENEROIDEA			
Corbicula	2		-99
Sphaeriidae	3	1	

Aquid Invertebrate Database Bench Sheet Report
Mineral Fk [0602652], Station #2, Sample Date: 3/29/2006 10:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	16	16	9
AMPHIPODA			
Hyalella azteca		1	6
Stygobromus		2	
COLEOPTERA			
Berosus		2	
Dubiraphia		12	15
Ectopria nervosa		1	
Hydroporus			2
Macronychus glabratus	2		
Optioservus sandersoni	81	14	4
Peltodytes			1
Psephenus herricki	1	3	
Stenelmis	11	9	2
DECAPODA			
Orconectes luteus		1	1
Orconectes punctimanus			1
DIPTERA			
Ablabesmyia		5	2
Atherix			-99
Cardiocladius	1		
Ceratopogoninae		3	1
Chironomus		1	
Cladotanytarsus		1	
Clinocera	6	3	
Corynoneura			7
Cricotopus bicinctus			9
Cricotopus/Orthocladius	16	2	29
Cryptochironomus		2	2
Dicrotendipes		5	1
Diptera		5	
Eukiefferiella brevicalcar grp	2		
Hemerodromia	4	2	3
Hydrobaenus			1
Labrundinia			11
Limonia		1	
Micropsectra			1
Nanocladius		1	4
Nilotanypus		1	
Paracladopelma		1	
Parakiefferiella		21	1
Parametriocnemus	3		
Paraphaenocladius			1
Paratanytarsus			10
Paratendipes		5	1
Phaenopsectra		25	
Polypedilum convictum grp	7	1	2
Polypedilum halterale grp		1	

Aquid Invertebrate Database Bench Sheet Report
Mineral Fk [0602652], Station #2, Sample Date: 3/29/2006 10:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum illinoense grp	1	1	11
Polypedilum scalaenum grp		4	
Prosimulium	13		
Protoplasa fitchii		1	
Pseudochironomus		1	
Rheocricotopus	2	2	1
Rheotanytarsus	3	2	9
Simulium	28		1
Stratiomys			-99
Sympotthastia			2
Tabanus	-99		
Tanytarsus	3	9	21
Thienemanniella	1		9
Thienemannimyia grp.	4	1	9
Tipula		1	-99
EPHEMEROPTERA			
Acentrella	11		
Caenis latipennis	9	29	24
Ephemerella invaria	102	1	3
Ephemerella needhami	26	1	31
Eurylophella bicolor		15	11
Isonychia bicolor	28	2	5
Rhithrogena	4		
Stenacron	4	3	1
Stenonema femoratum		2	
Stenonema mediopunctatum	33	1	
Stenonema pulchellum	13		2
Stenonema terminatum		2	
Tricorythodes	44	23	25
HEMIPTERA			
Microvelia			1
ISOPODA			
Caecidotea	1	1	
Caecidotea (Blind & Unpigmented)		9	
LIMNOPHILA			
Fossaria	2		
Gyraulus	1	1	
Helisoma		-99	
LUMBRICINA			
Lumbricina		3	
MEGALOPTERA			
Corydalus	1		
MESOGASTROPODA			
Elimia	1	1	
ODONATA			
Argia			1
Basiaeschna janata			-99
Boyeria			-99
Calopteryx			2

Aquid Invertebrate Database Bench Sheet Report
Mineral Fk [0602652], Station #2, Sample Date: 3/29/2006 10:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Enallagma			4
Gomphidae	3		
Hagenius brevistylus			1
Perithemis			1
Plathemis		-99	
Somatochlora			-99
Stylogomphus albistylus		3	-99
Tetragoneuria			1
PLECOPTERA			
Acroneuria	-99		
Amphinemura	1		
Leuctridae	4	2	
Perlesta			17
Prostoia	2		
Pteronarcys pictetii	9		2
TRICHOPTERA			
Ceratopsyche	2		
Cheumatopsyche	61	4	3
Chimarra	1		
Helicopsyche	1		
Hydropsyche			2
Hydroptila	1		6
Mystacides		5	1
Nectopsyche			2
Neureclipsis		1	
Oecetis			1
Oxyethira		1	2
Polycentropus			3
Pycnopsyche			-99
Triaenodes		2	1
TRICLADIDA			
Planariidae	2		
TUBIFICIDA			
Enchytraeidae		1	
Limnodrilus cervix			1
Limnodrilus hoffmeisteri		4	
Tubificidae		7	1
VENEROIDEA			
Corbicula		8	

Aquid Invertebrate Database Bench Sheet Report
Mineral Fk [0602651], Station #1, Sample Date: 3/28/2006 3:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	20	26	
AMPHIPODA			
Hyalella azteca			3
Stygobromus		1	
COLEOPTERA			
Ancyronyx variegatus		1	1
Berosus			1
Dubiraphia		8	10
Hydrochus	1		
Macronychus glabratus			2
Microcylloepus pusillus			1
Optioservus sandersoni	9		
Psephenus herricki	2		
Stenelmis	51	4	1
DECAPODA			
Orconectes luteus		-99	
DIPTERA			
Ablabesmyia		5	
Ceratopogoninae	2	13	2
Cladotanytarsus		3	
Clinocera	7	1	
Corynoneura	1		1
Cricotopus trifascia	1		
Cricotopus/Orthocladius	3		13
Cryptochironomus		3	
Dicrotendipes		1	1
Eukiefferiella	3		
Hemerodromia	8	2	
Labrundinia			2
Micropsectra			1
Microtendipes	4	1	
Parakiefferiella		61	1
Parametriocnemus	19	9	
Paratanytarsus			14
Phaenopsectra		6	
Polypedilum convictum grp	1		
Polypedilum fallax grp	1		
Polypedilum illinoense grp		5	1
Polypedilum scalaenum grp		3	
Pseudochironomus	1	6	
Rheocricotopus	2		
Robackia	3		
Simulium	5		
Stempellinella		12	
Tanytarsus	1	17	13
Thienemanniella			2
Thienemannimyia grp.	1	8	2
EPHEMEROPTERA			

Aquid Invertebrate Database Bench Sheet Report
Mineral Fk [0602651], Station #1, Sample Date: 3/28/2006 3:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Acentrella	10		
Caenis anceps		8	1
Caenis latipennis	27	79	76
Ephemerella invaria	131	8	3
Ephemerella needhami	14		26
Eurylophella bicolor	1	3	4
Heptageniidae	32	2	1
Isonychia bicolor	11		2
Procloeon	1		
Rhithrogena		1	
Stenacron	1	11	2
Stenonema femoratum	2	3	1
Stenonema mediopunctatum	43	1	
Stenonema pulchellum	7	2	
Stenonema terminatum	10	3	
Tricorythodes	55	7	41
ISOPODA			
Caecidotea (Blind & Unpigmented)		2	
LIMNOPHILA			
Helisoma		1	-99
Menetus			2
Physella		2	
LUMBRICINA			
Lumbricina	9	1	-99
MEGALOPTERA			
Corydalus	1		
MESOGASTROPODA			
Elimia	2	1	3
ODONATA			
Basiaeschna janata			-99
Boyeria			1
Calopteryx			2
Dromogomphus			-99
Enallagma			4
Gomphidae		1	
Hetaerina			1
Macromia		-99	1
PLECOPTERA			
Neoperla	1		
Perlesta	7		8
Perlinella ephyre	1		
Pteronarcys pictetii	6	1	1
TRICHOPTERA			
Agapetus	1		
Cheumatopsyche	60		1
Chimarra	3		
Helicopsyche	9	1	2
Hydropsyche			2
Hydroptila	1	2	4

Aquid Invertebrate Database Bench Sheet Report
Mineral Fk [0602651], Station #1, Sample Date: 3/28/2006 3:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Mystacides		4	
Nectopsyche			6
Oecetis		2	4
Oxyethira			5
Polycentropus		1	
Psychomyia	2		
Pycnopsyche			-99
Setodes	2		
Triaenodes			1
TRICLADIDA			
Planariidae	2	1	
VENEROIDEA			
Sphaeriidae	1	4	