

2012 Monitoring Summary



Mulberry Fork on private property near Cullman County Road 501(33.95045/-86.83842)

BACKGROUND

The Mulberry Fork drainage encompasses 2,366 mi² in north central Alabama, spanning five counties—Blount, Cullman, Winston, Walker, and Jefferson. The variety of distinct habitats within this river system has produced very diverse biological communities. The upper Mulberry Fork, above the Broglen River, provides habitat for a diverse fish community. Twenty-seven fish species have been identified in the upper reaches of the river. However, diversity diminishes downstream in the lower Mulberry Fork.

During 2011 and 2012, the Alabama Department of Conservation and Natural Resources (ADCNR) conducted a survey of aquatic snails in the Black Warrior River basin. Surveys were conducted at twelve sites in the Mulberry Fork drainage, six of which were on the mainstem of the river. Four of those six sites yielded results with only pulmonates found at the site, no snails collected, or habitat too poor to sample. Five different species of snails were identified in Mulberry Fork.

A 38 mile stretch of the Mulberry Fork, from Marriott Creek near I-65 in Cullman County upstream to Blount County Road 6 near Brooksville, has been on Alabama’s Clean Water Act (CWA) §303(d) list of impaired waters since 1998. It was listed for nutrients and siltation/habitat alteration from agricultural, industrial, and municipal sources.

The Alabama Department of Environmental Management (ADEM) conducted an intensive survey of the Mulberry Fork watershed in 2012. The objective of the survey was to collect data to develop nutrient and siltation Total Maximum Daily Loads (TMDLs) for the impaired segments. Ten stations on the mainstem of Mulberry Fork were sampled in 2012 (Figure 1). Macroinvertebrate assessments were conducted at three of these locations. Parameters included monthly in-situ measurements, flow, and water samples for lab analysis. Additionally, collection of composite samples from major point sources, time-of-travel (TOT) analyses, and 72-hour surveys of dissolved oxygen, temperature, pH, and conductivity were conducted at seven of the ten sites in June and September. The purpose of this report is to summarize the results of the macroinvertebrate assessment conducted at MBFB-13.

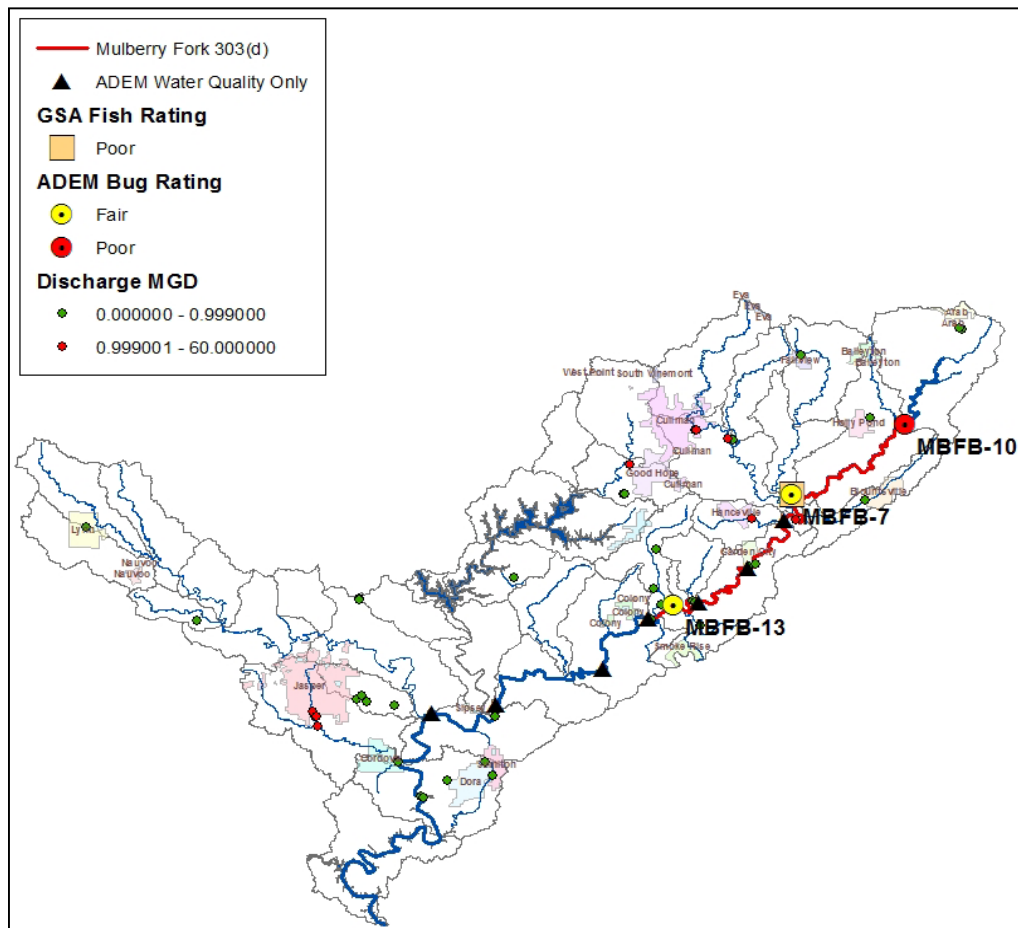


Figure 1. The locations of the sampling stations on the mainstem of Mulberry Fork. The 303(d) listed segments of Mulberry Fork are shown in red. Results of a fish IBI survey conducted by the Geological Survey of Alabama (GSA) and macroinvertebrate bioassessments conducted by ADEM are also shown (modified from ADEM Water Quality).

WATERSHED CHARACTERISTICS

Watershed characteristics are summarized in Table 1. Mulberry Fork at MBFB-13 is classified as a *Fish & Wildlife (F&W)* stream located in Cullman County. Based on the 2006 National Land Cover Dataset, landuse within the watershed is predominantly pasture land with some forest (34%) (Figure 2). About ten percent of the area is developed. As of June 6, 2013, a total of 109 NPDES permits have been issued in the watershed, most of which are construction storm-water permits.

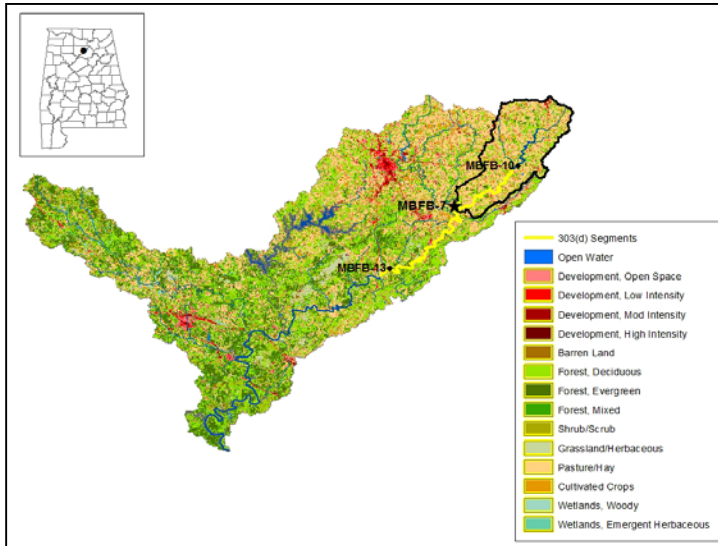


Figure 2. Sampling locations and landuse within the Mulberry Fork watershed. The 303(d) listed segments of the Mulberry Fork are shown in yellow.

REACH CHARACTERISTICS

General observations (Table 2) and a habitat assessment (Table 3) were completed during the macroinvertebrate assessment. In comparison with reference reaches in the same ecoregion, they give an indication of the physical condition of the site and the quality and availability of habitat. Mulberry Fork at MBFB-13 is a riffle-run stream located in the Dissected Plateau (68e) ecoregion (Figure 3). Benthic substrate consists primarily of bedrock. Overall habitat quality was rated as *sub-optimal* for supporting biological communities.



Figure 3. Mulberry Fork at MBFB-13, October 30, 2012.

Table 1. Summary of watershed characteristics.

Watershed Characteristics		Black Warrior River
Basin		Black Warrior River
Drainage Area (mi²)		417
Ecoregion^a		68e
% Landuse		
Open water		1
Wetland	Woody	1
	Emergent herbaceous	<1
Forest	Deciduous	23
	Evergreen	6
	Mixed	5
Shrub/scrub		6
Grassland/herbaceous		3
Pasture/hay		40
Cultivated crops		6
Development	Open space	6
	Low intensity	3
	Moderate intensity	1
	High intensity	<1
Barren		<1
Population/km^{2b}		50
# NPDES Permits^c	TOTAL	109
401 Water Quality Certification		2
Construction Stormwater		57
Mining		1
Industrial General		35
Industrial Individual		5
Underground Injection Control		9

a. Dissected Plateau

b. 2000 US Census

c. #NPDES permits downloaded from ADEM's NPDES Management System database, June 6, 2013.

Table 2. Physical characteristics of Mulberry Fork at MBFB-13, October 24, 2012.

Physical Characteristics	
Width (ft)	80
Canopy Cover	Open
Depth (ft)	
	Riffle 1.0
	Run 1.5
	Pool 1.5
% of Reach	
	Riffle 10
	Run 85
	Pool 5
% Substrate	
	Bedrock 60
	Boulder 10
	Cobble 5
	Gravel 5
	Sand 5
	Silt 5
	Organic Matter 10

PERIPHYTON RESULTS

Excessive algal growth can indicate nutrient enrichment. Benthic substrate covered by filamentous algae causes habitat degradation and habitat smothering. Periphyton assessments were conducted in accordance with ADEM's 2005 Revised Periphyton Protocol. Results of periphyton sampling in relationship to stream flow are presented in Figure 4. Percent filamentous algae cover was 64%. However, the substrate may have been scoured. Mean daily discharge data from the nearest USGS gage station suggest stream flow peaked during the week preceding sampling.

MACROINVERTEBRATE RESULTS

Benthic macroinvertebrate communities were sampled using ADEM's Intensive Multi-habitat Bioassessment methodology (WMB-I). The WMB-I measures taxonomic richness, community composition, and community tolerance to assess the overall health of the macroinvertebrate community. Each score is based on a six point scale in comparison to least-impaired reference reaches characterized by similar drainage areas, gradient, and habitat. The final score is the sum of all metric scores, with a maximum score of 30. The metric results indicated the macroinvertebrate community to be in *fair* condition (Table 4).

WATER CHEMISTRY

Results of water chemistry analyses are presented in Table 5. When possible, in situ measurements and water samples were collected monthly or semi-monthly during April through November 2012 to help identify any stressors to the biological communities. Median conductivity and concentrations of total dissolved solids, hardness, alkalinity, nitrate-nitrite-nitrogen, total nitrogen, dissolved reactive phosphorus, total phosphorus, chlorides, and total manganese were higher than expected for streams in the Dissected Plateaus ecoregion. Ammonia-nitrogen was above the minimum detection limit in five of ten samples collected. However, the median ammonia-nitrogen concentration was below values expected for the ecoregion.

While dissolved oxygen (DO) met *F&W* criterion during all monthly sampling visits, pH exceeded *F&W* criterion on two sampling visits. In addition, pH concentrations violated these criteria during two 72-hour diurnal studies, one conducted June 18-21 and one conducted September 10-13, 2012. Dissolved oxygen, water temperature, pH, and conductivity were measured every fifteen minutes for 72 hours. Results of the study June and September studies are shown in Figures 5 and 6, respectively. In June, DO in the water column changed approximately 3.4-4.3 mg/L in a diurnal cycle, ranging from 7.9 mg/L to 12.4 mg/L. Stream pH ranged from 8.4 to 9.0 during the study and was out of compliance for 56 hours during the course of the study. In September, DO in the water column changed approximately 2.2 mg/L in a diurnal cycle, and ranged from 7.5 mg/L to 10.2 mg/L. Stream pH ranged from 7.4 to 8.6, and was out of compliance for 1.5 hours during the study.

Table 3. Results of the habitat assessment conducted in Mulberry Fork at MBFB-13 on October 24, 2012.

Habitat Assessment	%Maximum Score	Rating
RR		
Instream Habitat Quality	58	Marginal (41-58)
Sediment Deposition	78	Optimal (>70)
Sinuosity	63	Marginal (45-64)
Bank and Vegetative Stability	74	Sub-optimal (60-74)
Riparian Buffer	49	Poor (<50)
Habitat Assessment Score	159	
% Maximum Score	66	Sub-optimal (59-70)

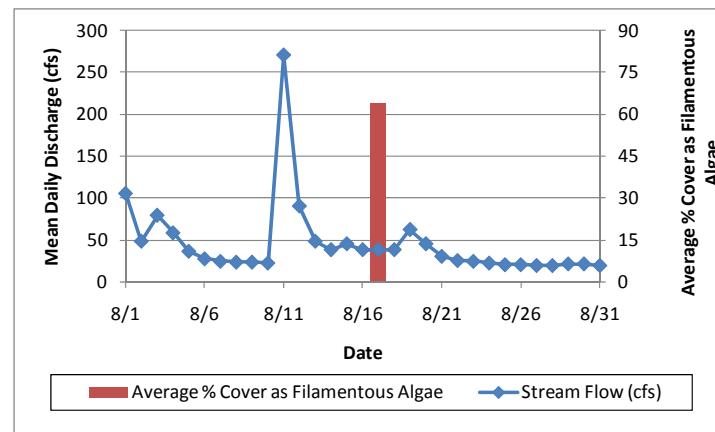


Figure 4. Results of periphyton sampling at MBFB-13 conducted August, 2012. The blue line indicates mean daily stream flow during the month of August 2012.

Table 4. Results of the macroinvertebrate bioassessment conducted in Mulberry Fork at MBFB-13 on October 24, 2012.

Macroinvertebrate Assessment		
	Results	Scores
Taxa richness and diversity measures		
# EPT taxa	19	4
Taxonomic composition measures		
# Clinger taxa	20	2
Tolerance measures		
Beck's community tolerance index	6	0
% Nutrient tolerant organisms	50	0
% Tolerant taxa	32	6
WMB-I Assessment Score	---	12
WMB-I Assessment Rating		Fair (12-23)

Table 5. Summary of water quality data collected April-November, 2012. Minimum (Min) and maximum (Max) values calculated using minimum detection limits (MDL) when results were less than this value. Median, average (Avg), and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

Parameter	N	Min	Max	Med	Avg	SD	E
Physical							
Temperature (°C)	13	9.9	31.6	26.4	24.5	6.8	
Turbidity (NTU)	13	2.3	20.6	7.0	7.4	4.9	
Total Dissolved Solids (mg/L)	10	88.0	190.0	123.0 ^M	125.4	33.1	
^J Total Suspended Solids (mg/L)	10	< 1.0	19.0	5.0	6.2	5.6	
Specific Conductance (µmhos)	13	144.8	308.6	212.2 ^G	212.3	45.0	
Hardness (mg/L)	7	48.1	79.9	71.5 ^G	65.4	12.5	
Alkalinity (mg/L)	10	44.0	83.9	67.1 ^M	67.0	12.7	
Stream Flow (cfs)	8	15.5	661.4	42.8	139.0	220.0	
Chemical							
Dissolved Oxygen (mg/L)	13	5.8	12.2	9.9	9.8	1.8	
pH (su)	13	7.5	9.0 ^C	8.2	8.2	0.5	2
Ammonia Nitrogen (mg/L)	10	< 0.007	0.125	0.024	0.042	0.045	
Nitrate+Nitrite Nitrogen (mg/L)	10	0.093	4.865	1.853 ^M	2.007	1.570	
^J Total Kjeldahl Nitrogen (mg/L)	10	0.120	0.745	0.502	0.454	0.186	
^J Total Nitrogen (mg/L)	10	0.545	5.492	2.289 ^M	2.461	1.674	
Dissolved Reactive Phosphorus (mg/L)	10	0.153	0.536	0.313 ^M	0.343	0.143	
Total Phosphorus (mg/L)	10	0.220	0.605	0.337 ^M	0.399	0.154	
^J CBOD-5 (mg/L)	10	< 2.0	< 2.0	1.0	1.0	0.0	
Chlorides (mg/L)	10	6.3	22.0	13.4 ^M	13.1	4.6	
Total Metals							
^J Aluminum (mg/L)	5	< 0.043	0.330	0.083	0.154	0.144	
^J Iron (mg/L)	5	< 0.019	0.406	0.223	0.218	0.151	
^J Manganese (mg/L)	5	0.018	0.187	0.057 ^M	0.071	0.068	
Dissolved Metals							
Aluminum (mg/L)	5	< 0.043	< 0.043	0.022	0.022	0.000	
Antimony (µg/L)	5	< 3.6	< 3.6	1.8	1.8	0.0	
Arsenic (µg/L)	5	< 1.8	< 1.8	0.9	0.9	0.0	
Cadmium (µg/L)	5	< 0.022	< 0.046	0.023	0.021	0.005	
Chromium (mg/L)	5	< 0.009	< 0.009	0.004	0.004	0.000	
Copper (mg/L)	5	< 0.020	< 0.020	0.010	0.010	0.000	
^J Iron (mg/L)	5	< 0.019	0.085	0.026	0.038	0.034	
Lead (µg/L)	5	< 0.9	< 0.9	0.4	0.4	0.0	
^J Manganese (mg/L)	5	0.018	0.037	0.025	0.028	0.008	
Mercury (µg/L)	5	< 0.035	< 0.035	0.018	0.018	0.000	
Nickel (mg/L)	5	< 0.042	< 0.042	0.021	0.021	0.000	
Selenium (µg/L)	5	< 2.5	< 2.5	1.2	1.2	0.0	
Silver (µg/L)	5	< 0.015	0.215	0.108	0.088	0.045	
Thallium (µg/L)	5	< 1.4	< 1.4	0.7	0.7	0.0	
Zinc (mg/L)	5	< 0.012	< 0.012	0.006	0.006	0.000	
Biological							
Chlorophyll a (ug/L)	10	< 0.10	11.21	2.27	3.58	4.14	
^J E. coli (col/100mL)	5	19	108	23	42	38	

C=F&W criteria violated; E=# samples that exceeded criteria; G=value higher than median concentration of all verified ecoregional reference reach data collected in the ecoregion 68e; J=estimate; M=value >90% of all verified ecoregional reference reach data collected in the ecoregion 68e; N= # samples.

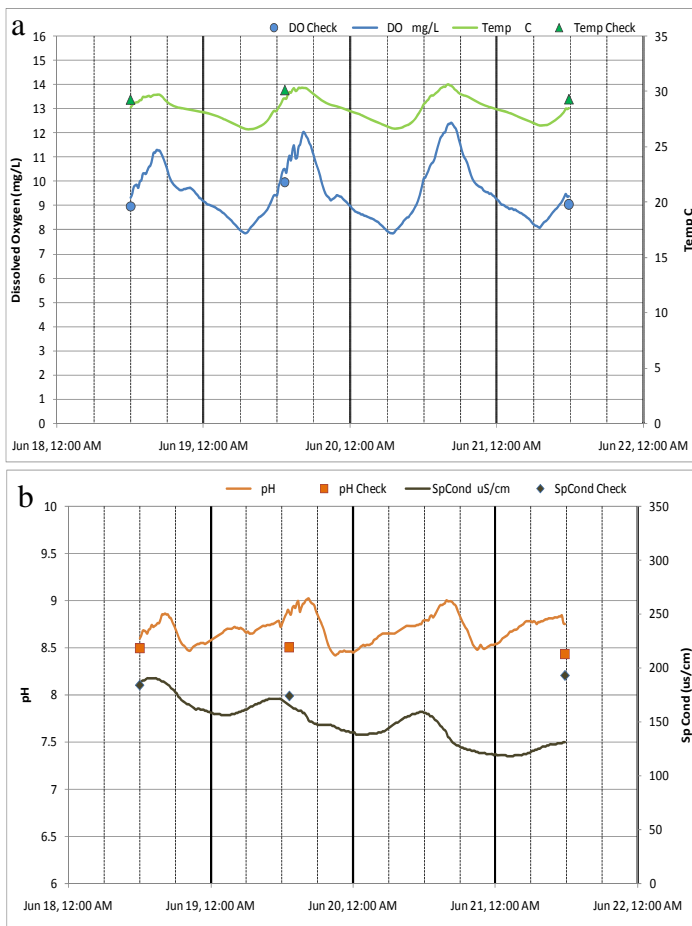


Figure 5. Results of 72-hour diurnal study conducted June 18-21, 2012. Lines indicate changes in DO and water temperature (a) and pH and conductivity (b) over time (courtesy of ADEM Water Quality).

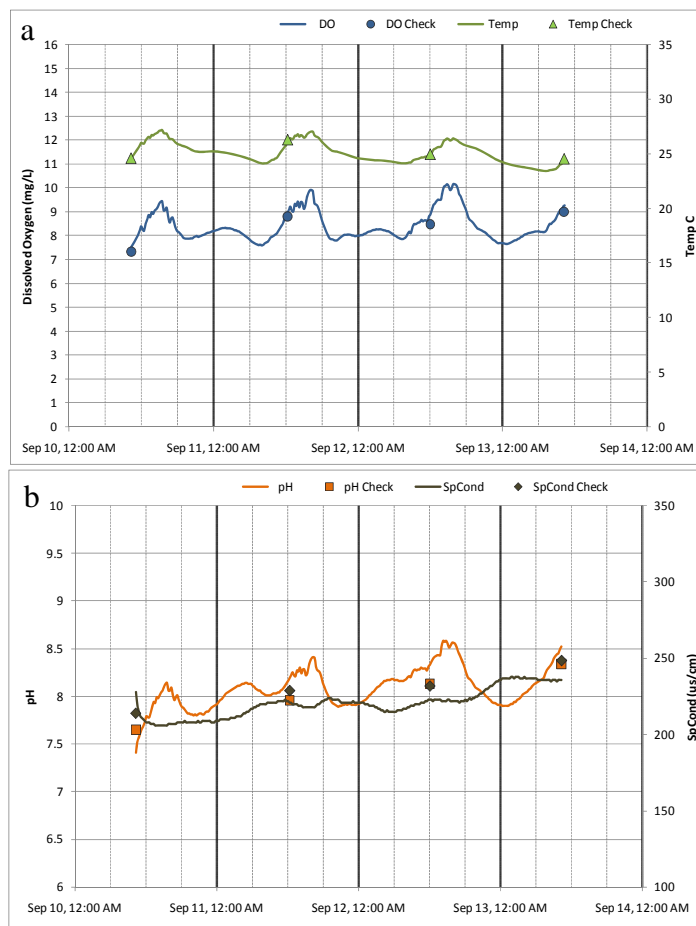


Figure 6. Results of 72-hour diurnal study conducted September 10-13, 2012. Lines indicate changes in DO and water temperature (a) and pH and conductivity (b) over time (courtesy of ADEM Water Quality).

DISCUSSION

Three segments of the Mulberry Fork are currently classified as impaired according to §303(d) of the Clean Water Act. The segments are impaired by nutrients and siltation/habitat alteration from agricultural, industrial, and municipal sources.

Overall habitat quality was categorized as *sub-optimal* for supporting macroinvertebrate communities. Results of the macroinvertebrate bioassessment conducted at MBFB-13 indicated the aquatic insect community to be in *fair* condition.

Water chemistry analyses showed median conductivity, total dissolved solids, hardness, alkalinity, nitrate-nitrite nitrogen, total nitrogen, dissolved reactive phosphorus, total phosphorus, chlorides, and total manganese were elevated as compared to data from ADEM's least-impaired reference reaches in ecoregion 68e. Stream pH violated *F&W* criteria during two sampling events. These results were corroborated by two 72-hour studies conducted in both June and September that showed pH was out of compliance both times. While the diurnal change in pH was less in the June study, values exceeded *F&W* criterion for 56 hours during the study. In September, pH was out of compliance for 1.5 hours, and it changed almost an order of magnitude in a 24-hour period. These swings in pH suggest that nutrient enrichment may be a problem in the reach. Continued monitoring of this reach is recommended.

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