Alabama Department of Environmental Management

303(d)/TMDL Monitoring Site

Rivers and Streams Monitoring Program

2012 Monitoring Summary

Fair

Locust Fork at Center Springs Road near Vaughn's Bridge in Blount County (33.88849/-86.69532)

BACKGROUND

The Locust Fork drainage encompasses 1,209 mi^2 in north central Alabama, spanning five counties—Blount, Marshall, Etowah, Walker, and Jefferson. The variety of distinct habitats within this river system has produced very diverse biological communities. Several threatened and endangered species inhabit the river, including five species of mussels and four species of fish.

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. Thirteen sites were sampled on the Locust Fork, and at least thirteen different species of snails were identified. One of the snail species was *Leptoxis plicata*, a federally endangered species found only in Alabama.

A 75 mile stretch of the Locust Fork, from Alabama Highway 269 near Short Creek in Jefferson County upstream to Blount County Road 30, 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 and abandoned surface mining sources.

The Alabama Department of Environmental Management (ADEM) conducted an intensive survey of the Locust 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. The intensive survey included a total of seven stations on the mainstem of Locust Fork (Figure 1). Macroinvertebrate assessments were conducted at five of these locations. Seventy-two hour surveys of dissolved oxygen, temperature, pH, and conductivity were also conducted at six of the seven sites. Parameters included monthly in-situ measurements, flow, and water samples for lab analysis. The purpose of this report is to summarize the results of the macroinvertebrate assessment conducted at LFKB-2.

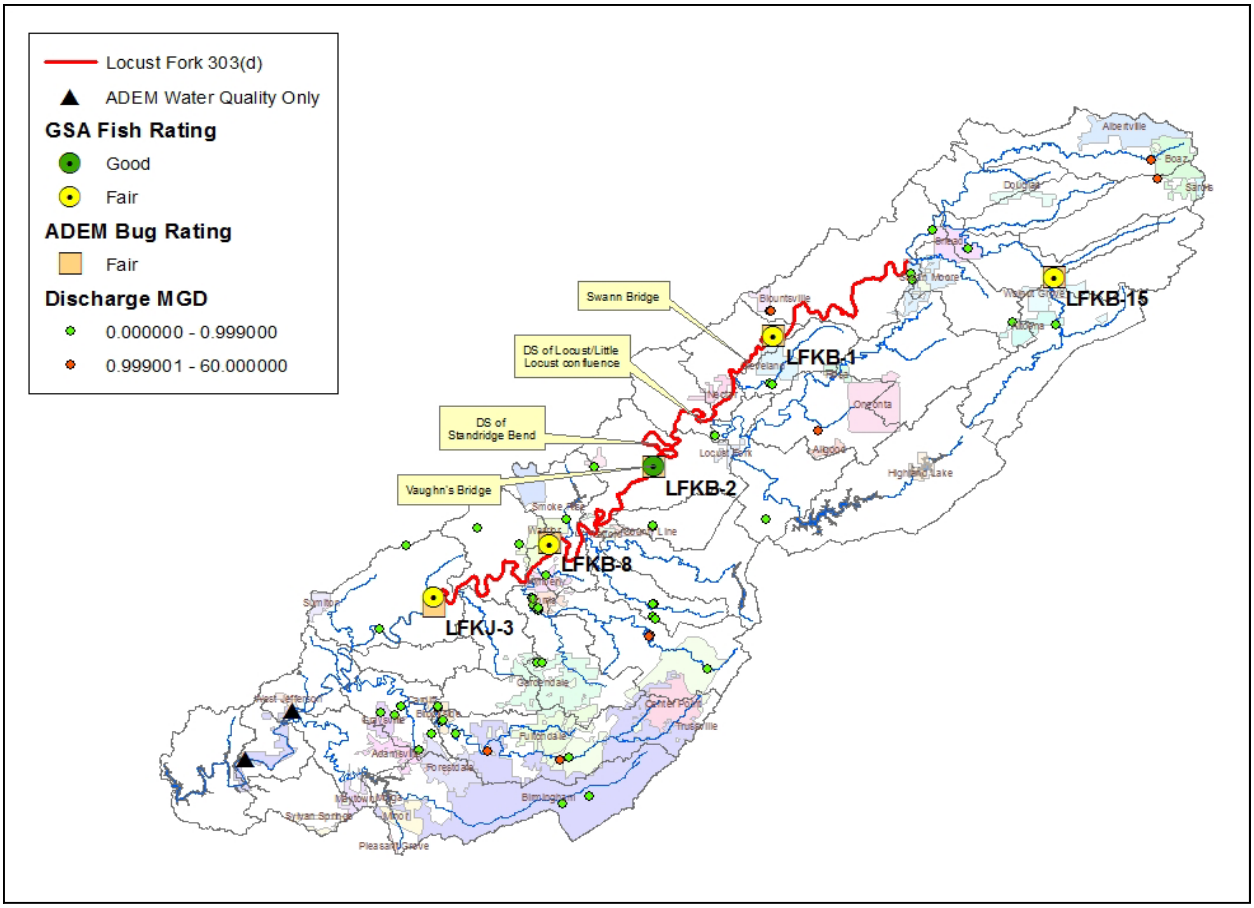

Figure 1. The locations of the five RSMP sampling stations on the mainstem of Locust Fork. The 303(d) listed segments of the Locust Fork are shown in red. Results of fish IBI surveys conducted by the Geological Survey of Alabama (GSA) and macroinvertebrate bioassessments conducted by ADEM are also shown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

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WATERSHED CHARACTERISTICS

Watershed characteristics are summarized in Table 1. Locust Fork at LFKB-2 is classified as a *Fish & Wildlife (F&W)* stream located in Blount County. Based on the 2006 National Land Cover Dataset, landuse within the watershed is predominantly forest (45%) and pasture land (Figure 2). About seven percent of the area is developed. As of June 6, 2013, a total of 190 NPDES permits have been issued in the watershed, most of which are mining permits.

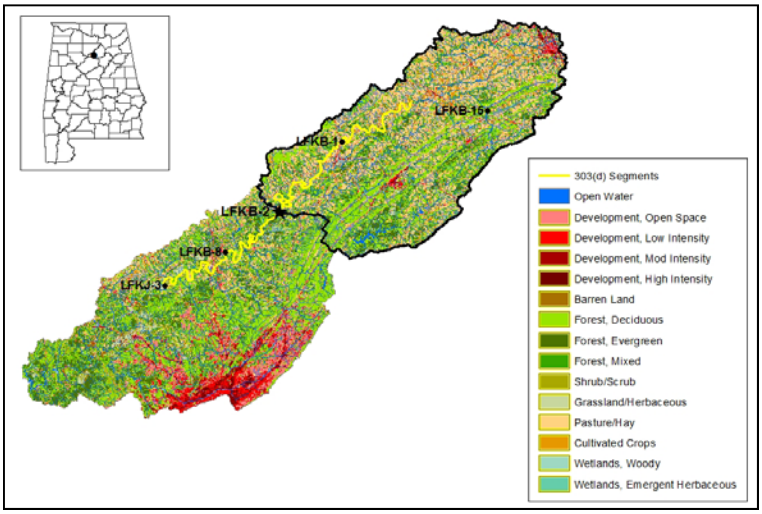

Figure 2. Sampling locations and landuse within the Locust Fork watershed. The 303 (d) listed segments of the Locust Fork are shown in yellow.

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. Locust Fork at LFKB-2 is a riffle-run stream located in the Dissected Plateau (68e) ecoregion (Figure 3). Benthic substrate consists primarily of gravel, with some sand, boulder, and cobble. Overall habitat quality was rated as *sub-optimal* for supporting biological communities. However, bank and vegetative stability was *marginal* in the reach due to signs of bank erosion, and riffle frequency was *poor*.

Figure 3. Locust Fork at LFKB-2, June 20, 2012.

Table 1. Summary of watershed characteristics.

Watershed Characteristics		
Basin		Black Warrior River
Drainage Area (mi^2)		579
Ecoregion[a]		68e
Ichthyoregion[b]		PLA
% Landuse		
Open water		<1
Wetland	Woody	1
	Emergent herbaceous	<1
Forest	Deciduous	28
	Evergreen	9
	Mixed	8
Shrub/scrub		5
Grassland/herbaceous		4
Pasture/hay		32
Cultivated crops		6
Development	Open space	5
	Low intensity	2
	Moderate intensity	<1
	High intensity	<1
Barren		<1
Population/km^2[c]		35
# NPDES Permits[d]	**TOTAL**	190
Mining		86
Industrial General		65
Industrial Individual		8
Municipal Individual		17
Underground Injection Control		11

a. Dissected Plateau

b. Plateau

c. 2000 US Census

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

Table 2. Physical characteristics of Locust Fork at LFKB-2, June 20, 2012.

Physical Characteristics		
Width (ft)		100
Canopy Cover		Open
Depth (ft)		
	Riffle	1.1
	Run	1.5
	Pool	2.0
% of Reach		
	Riffle	20
	Run	50
	Pool	30
% Substrate		
	Boulder	17
	Cobble	17
	Gravel	33
	Sand	23
	Silt	7
	Clay	3

MACROINVERTEBRATE RESULTS

Benthic macroinvertebrate communities were sampled using ADEM's Nonwadeable Multi-habitat Bioassessment methodology (NWM-I). The NWM-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, reflecting the shift from sensitive taxa to more tolerant taxa (Table 4).

FISH RESULTS

The Geological Survey of Alabama (GSA) conducted fish IBI assessments of the Locust Fork in 2010 and 2011. These data provide information about the species richness and diversity, tolerance level, trophic system, and abundance of the fish community. Each score is a five-point scale in comparison to least-impaired reference reaches in the same ichthyoregion. The final score is the sum of all metric scores, with a maximum score of 60. Metric results indicated the fish community to be in *good* condition (Table 5). However, the taxonomic composition of the fish community reflect the loss of some sensitive taxa, and presence of some more tolerant taxa.

WATER CHEMISTRY

Results of water chemistry analyses are presented in Table 6. When possible, in situ measurements and water samples were collected monthly during April through November 2012 to help identify any stressors to the biological communities. The median concentrations of total dissolved solids, alkalinity, nitrate-nitrite nitrogen, total nitrogen, dissolved reactive phosphorus, total phosphorus, and chlorides were higher than expected for streams in the Dissected Plateaus ecoregion. Specific conductance was also higher than expected for the area. Ammonia-nitrogen was above the minimum detection limit in two of eight 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 one sampling event on October 10, 2012. In addition, pH concentrations violated these criterion during a 72-hour diurnal study conducted July 23-26, 2012. Dissolved oxygen, water temperature, pH, and conductivity were measured every fifteen minutes for 72 hours. Results of the study are shown in Figure 4. On average, the DO in the water column changed approximately 4.5 mg/L in a diurnal cycle, ranging from 6.4 mg/L to 12.9 mg/L. Stream pH increased an order of magnitude in a diurnal cycle and ranged from 7.4 to 8.9 during the study. Also, stream pH was out of compliance for 10.5 hours during the 72-hour study.

Table 3. Results of the habitat assessment conducted in Locust Fork at LFKB-2 on June 20, 2012.

Habitat Assessment	% Maximum Score	Rating
NW		
Instream Habitat Quality	67	Sub-optimal (59-70)
Sediment Deposition	65	Sub-optimal (59-70)
Sinuosity	40	Poor (<45)
Bank and Vegetative Stability	59	Marginal (35-59)
Riparian Buffer	80	Sub-optimal (70-90)
Habitat Assessment Score	**163**	
% Maximum Score	**68**	**Sub-optimal (59-70)**

Table 4. Results of the macroinvertebrate bioassessment conducted in Locust Fork at LFKB-2 on June 20, 2012.

Macroinvertebrate Assessment		
	Results	**Scores**
Taxa richness and diversity measures		
# EPT taxa	18	2
Taxonomic composition measures		
# Clinger taxa	21	2
Tolerance measures		
Beck's community tolerance index	10	0
% Nutrient tolerant organisms	22	6
% Tolerant taxa	29	4
WMB-I Assessment Score	**---**	**14**
WMB-I Assessment Rating		**Fair (12-24)**

Table 5. Results of the fish IBI assessment conducted in Locust Fork at LFKB-2 on July 1, 2010 (GSA 2013).

Fish IBI Assessment	Results	Score
Species richness and diversity		
Total native species	25	3
Number cyprinid species	7	3
Number sucker species	1	1
Number *Lepomis* species	4	3
Number darter+madtom species	6	3
Tolerance and intolerance		
Percent dominant species	24	5
Percent of tolerant species	9	5
Percent *Lepomis*	1	5
Trophic Measures		
Percent omnivores	20	3
Percent carnivores	2	3
Abundance, condition, and reproduction		
Percent DELT+hybrids	0	5
Percent simple lithophils	43	5
Total IBI Score		**44**
IBI Assessment Rating		**Good (41-49)**

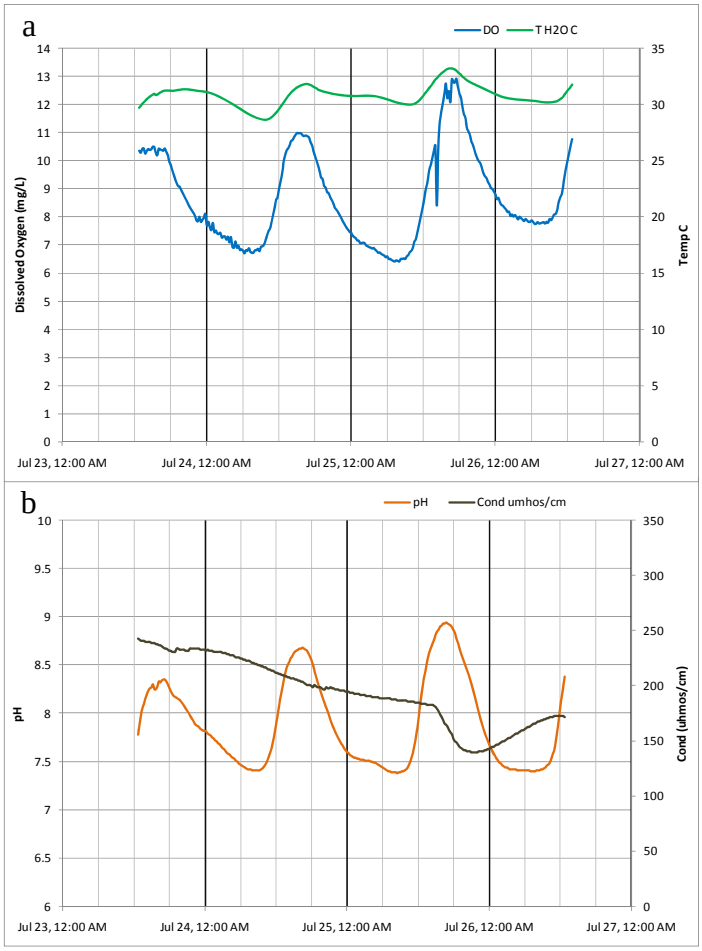

Figure 4. Results of 72-hour diurnal study conducted July 23-26, 2012. Lines indicate changes in DO and water temperature (a) and pH and conductivity (b) over time (courtesy of ADEM Water Quality).

Table 6. 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)	9	10.2	29.8	25.4 M	22.9	6.4	
Turbidity (NTU)	9	2.8	24.7	3.8	6.1	7.0	
Total Dissolved Solids (mg/L)	8	74.0	162.0	119.0 M	117.8	28.4	
J Total Suspended Solids (mg/L)	8	< 1.0	6.0	1.5	2.6	2.4	
Specific Conductance (µmhos)	9	53.8	231.1	165.9 G	169.0	55.5	
J Alkalinity (mg/L)	8	40.3	76.9	49.2 M	55.7	14.2	
Stream Flow (cfs)	8	79.4	254.6	127.3	145.4	63.3	
Chemical							
Dissolved Oxygen (mg/L)	9	6.4	11.8	8.7	8.8	2.0	
pH (su)	9	6.9	8.6 C	7.7	7.7	0.6	1
Ammonia Nitrogen (mg/L)	8	< 0.007	0.050	0.004	0.014	0.018	
Nitrate+Nitrite Nitrogen (mg/L)	8	0.778	2.422	1.011 M	1.188	0.546	
J Total Kjeldahl Nitrogen (mg/L)	8	0.133	0.580	0.451	0.427	0.154	
J Total Nitrogen (mg/L)	8	1.227	2.780	1.342 M	1.616	0.539	
Dissolved Reactive Phosphorus (mg/L)	8	0.072	0.438	0.193 M	0.207	0.118	
Total Phosphorus (mg/L)	8	0.098	0.455	0.214 M	0.234	0.117	
J CBOD-5 (mg/L)	8	< 2.0	< 2.0	1.0	1.0	0.0	
Chlorides (mg/L)	8	3.5	10.5	6.8 M	6.8	2.4	
Biological							
Chlorophyll a (ug/L)	8	< 0.10	4.27	0.80	1.21	1.35	

C=*F&W* criterion violated; E=# of 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.

DISCUSSION

Four segments of the Locust Fork are currently classified as impaired according to §303(d) of the Clean Water Act. The segments are impaired by nutrients, siltation, and other habitat alteration caused by unknown sources.

While overall habitat quality was categorized as *sub-optimal* for supporting macroinvertebrate communities, bank failure due to erosion was noted in the reach. Benthic substrate at LFKB-2 was mostly gravel, but sand and silt deposition could lead to the loss of critical habitat in the reach and have significant impacts on the biological communities. Results of the macroinvertebrate bioassessment conducted at LFKB-2 indicated the aquatic insect community to be in *fair* condition. A 2010 fish IBI survey conducted by the Geological Survey of Alabama (GSA) indicated the fish community at LFKB-2 to be in *good* condition.

While the macroinvertebrate and fish communities in the reach were rated as *fair* and *good*, respectively, biological surveys indicate moderate changes in the community structures due to the replacement of sensitive taxa by more tolerant taxa. Also, efforts to reintroduce aquatic snails and mussels at LFKB-2 have been variable. Continued monitoring of this reach is recommended.

Water chemistry analyses showed concentrations of total dissolved solids, alkalinity, nitrate-nitrite nitrogen, total nitrogen, dissolved reactive phosphorus, total phosphorus, and chlorides were elevated as compared to data from ADEM's least-impaired reference reaches in ecoregion 68e. Specific conductance was also higher than expected for the ecoregion. Stream pH values exceeded *F&W* criterion during one sampling event. These results were corroborated by a 72-hour study that showed pH increased an order of magnitude in a diurnal cycle, ranging from 7.4 to 8.9 during the study. Stream pH was above *F&W* criterion for 10.5 hours during the 72-hour study. This swing in pH, higher than in other areas of the river, suggests that nutrient enrichment may be a problem in the reach.

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