

2012 Monitoring Summary



Locust Fork at Jefferson County Road 77 (33.74402/-86.91853)

BACKGROUND

The Locust Fork drainage encompasses 1,209 mi² 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 LFKJ-3.

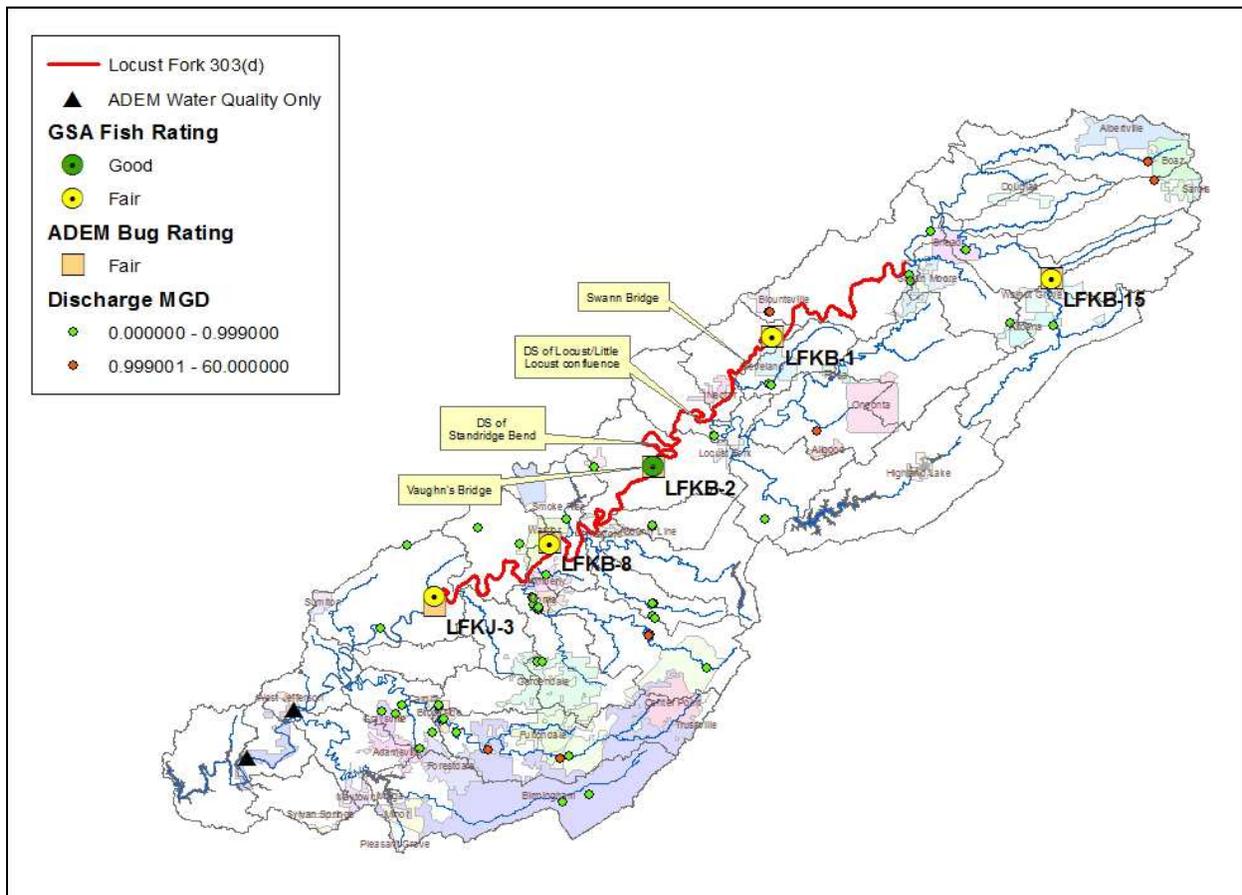


Figure 1. The locations of the five RSMP sampling stations on the mainstem of Locust Fork. The 303(d) listed segments of the Locust Fork are shown in red. Results of fish IBI surveys conducted by the Geological Survey of Alabama (GSA) and macroinvertebrate bioassessments conducted by ADEM are also shown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

WATERSHED CHARACTERISTICS

Watershed characteristics are summarized in Table 1. Locust Fork at LFKJ-3 is classified as a *Fish & Wildlife (F&W)* stream located in Jefferson County. Based on the 2006 National Land Cover Dataset, landuse within the watershed is predominantly forest (50%) and pasture land (Figure 2). About eight percent of the area is developed. As of June 6, 2013, a total of 210 NPDES permits have been issued in the watershed, most of which are construction stormwater permits.

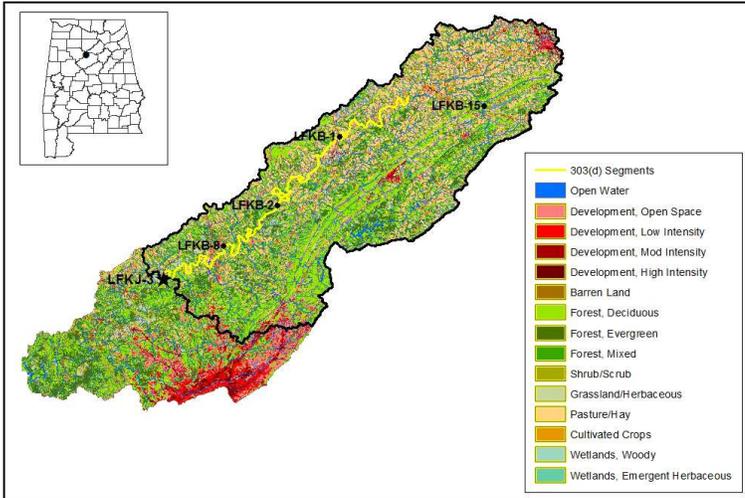


Figure 2. Sampling locations and landuse within the Locust Fork watershed. The 303 (d) listed segments of the Locust Fork are shown in yellow.

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 LFKJ-3 is a glide-pool stream located in the Shale Hills (68f) ecoregion (Figure 3). Benthic substrate consists primarily of boulder, with some sand and bedrock. Overall habitat quality was rated as *marginal* for supporting biological communities due to sediment deposition and bank failure in the reach.



Figure 3. Locust Fork at LFKJ-3, June 20, 2012.

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 relation to stream flow are presented in Figure 4. Percent filamentous algae cover was six percent. However, the substrate may have been scoured. Mean daily discharge data from the nearest USGS gage station suggest stream flow peaked during a high flow event early in the month.

Table 1. Summary of watershed characteristics.

Watershed Characteristics		Black Warrior River
Basin		
Drainage Area (mi²)		865
Ecoregion^a		68f
Ichthyoregion^b		PLA
% Landuse		
Open water		1
Wetland	Woody	1
	Emergent herbaceous	<1
Forest	Deciduous	33
	Evergreen	10
	Mixed	7
Shrub/scrub		5
Grassland/herbaceous		5
Pasture/hay		25
Cultivated crops		4
Development	Open space	6
	Low intensity	2
	Moderate intensity	<1
	High intensity	<1
Barren		<1
Population/km^{2c}		53
# NPDES Permits^d	TOTAL	210
	401 Water Quality Certification	3
	Construction Stormwater	111
	Mining	24
	Industrial General	61
	Industrial Individual	5
	Underground Injection Control	6

a. Shale Hills

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 LFKJ-3, June 20, 2012.

Physical Characteristics		
Width (ft)		100
Canopy Cover		Open
Depth (ft)		
	Run	2.4
	Pool	6.0
% of Reach		
	Run	57
	Pool	43
% Substrate		
	Bedrock	20
	Boulder	37
	Sand	30
	Silt	13

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 (Table 4).

Table 4. Results of the macroinvertebrate bioassessment conducted in Locust Fork at LFKJ-3 on June 20, 2012.

Macroinvertebrate Assessment		
	Results	Scores
Taxa richness and diversity measures		
# EPT taxa	13	2
Taxonomic composition measures		
# Clinger taxa	18	2
Tolerance measures		
Beck's community tolerance index	8	0
% Nutrient tolerant organisms	23	6
% Tolerant taxa	41	2
WMB-I Assessment Score	---	12
WMB-I Assessment Rating		Fair (12-24)

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 species richness and diversity, community tolerance, trophic composition, and abundance of the fish community. Each of the 12 metrics is scored 1, 3, or 5, with 1 indicating a poor or least desirable state and 5 a good or most desirable state. 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 *fair* condition (Table 5). For additional information, contact the Geological Survey of Alabama, Ecosystems Investigation Program.

WATER CHEMISTRY

Results of water chemistry analyses are presented in Table 6. 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. Dissolved thallium concentrations exceeded the human health criterion for fish consumption during one sampling event on October 10, 2012. Stream flow was normal at the time of sample collection. Median concentrations of total dissolved solids, hardness, alkalinity, dissolved reactive phosphorus, total phosphorus, and chlorophyll *a* were higher than expected for streams in ecoregion 68. Water temperature and conductivity were 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.

Table 3. Results of the habitat assessment conducted in Locust Fork at LFKB-1 on June 21, 2012.

Habitat Assessment	% Maximum Score	Rating
NW		
Instream Habitat Quality	52	Marginal (41-58)
Sediment Deposition	54	Marginal (41-58)
Sinuosity	75	Sub-optimal (65-84)
Bank and Vegetative Stability	46	Marginal (35-59)
Riparian Buffer	70	Sub-optimal (70-90)
Habitat Assessment Score	135	
% Maximum Score	56	Marginal (41-58)

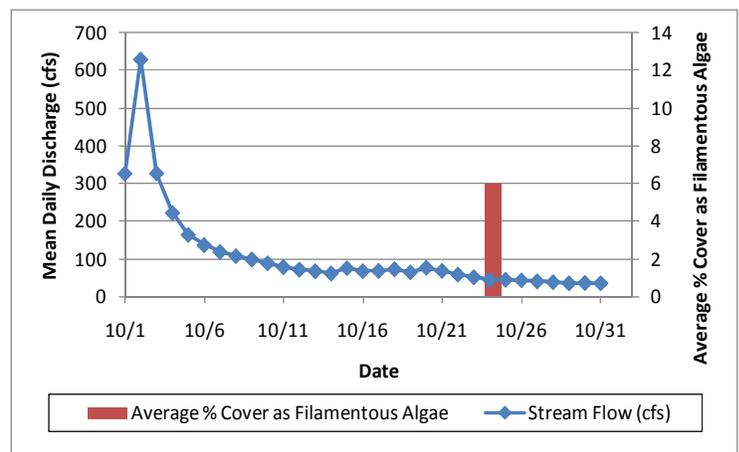


Figure 4. Results of periphyton sampling at LFKJ-3 conducted October 23, 2012. The blue line indicates mean daily stream flow during the month of October 2012.

Table 5. Results of the fish IBI assessment conducted in Locust Fork at LFKJ-3 on October 7, 2011 (GSA 2013).

Fish IBI Assessment	Results	Score
Species richness and diversity		
Total native species	21	3
Number cyprinid species	8	3
Number sucker species	2	3
Number <i>Lepomis</i> species	3	1
Number darter+madtom species	5	3
Tolerance and intolerance		
Percent dominant species	36	3
Percent of tolerant species	38	1
Percent <i>Lepomis</i>	5	5
Trophic Measures		
Percent omnivores	40	1
Percent carnivores	2	3
Abundance, condition, and reproduction		
Percent DELT+hybrids	0	5
Percent simple lithophils	37	3
Total IBI Score		34
IBI Assessment Rating		Fair (33-40)

WATER CHEMISTRY (CON'T)

Dissolved oxygen (DO) and pH met *F&W* use class criteria during all monthly sampling visits. In addition, DO and pH concentrations did not violate these criteria 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 5. On average, DO in the water column changed approximately 1.5 mg/L in a diurnal cycle, similar to the patterns observed at least-disturbed reference reaches.

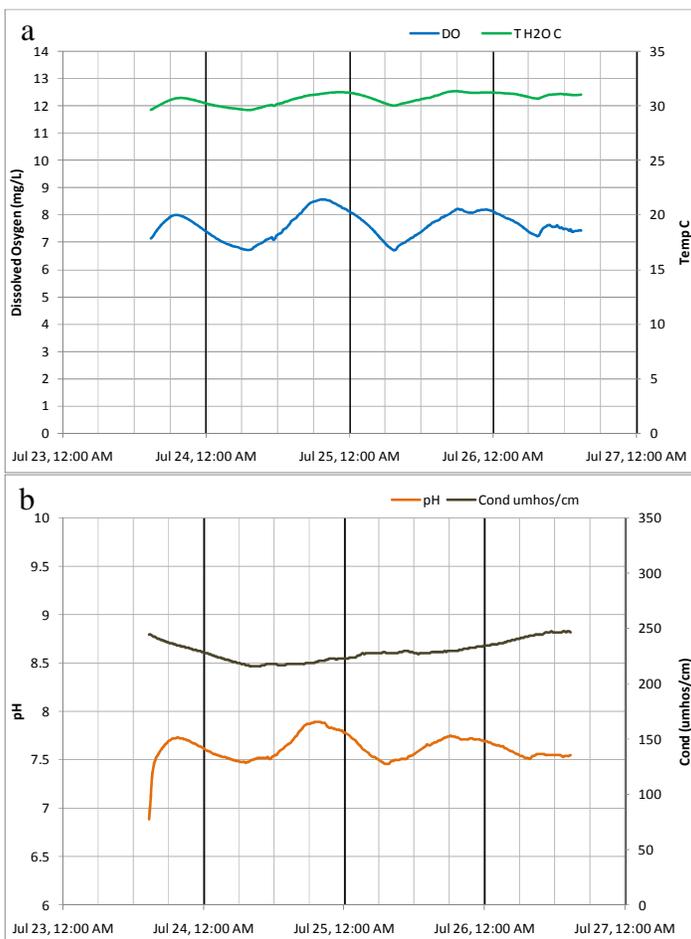


Figure 5. Results of 72-hour diurnal study conducted July 23-26, 2012. Lines indicate changes in DO and water temperature (a) and pH and conductivity (b) over time (courtesy of ADEM Water Quality).

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	10.4	28.8	25.3 ^M	22.7	6.0	
Turbidity (NTU)	9	4.0	27.2	8.6	10.2	6.8	
Total Dissolved Solids (mg/L)	8	128.0	210.0	165.0 ^M	168.2	30.4	
Total Suspended Solids (mg/L)	8	< 1.0	14.0	5.0	5.8	4.8	
Specific Conductance (µmhos)	9	154.8	292.1	241.1 ^G	238.9	43.1	
Hardness (mg/L)	4	72.1	104.0	92.9 ^G	90.5	14.1	
Alkalinity (mg/L)	8	50.8	87.2	69.6 ^M	71.3	14.0	
Stream Flow (cfs)	7	175.7	515.6	230.1	283.1	114.9	
Chemical							
Dissolved Oxygen (mg/L)	9	6.5	10.1	8.6	8.4	1.4	
pH (su)	9	6.7	7.8	7.3	7.3	0.4	
^J Ammonia Nitrogen (mg/L)	8	< 0.007	0.032	0.004	0.008	0.010	
Nitrate+Nitrite Nitrogen (mg/L)	8	0.191	0.936	0.614	0.610	0.220	
Total Kjeldahl Nitrogen (mg/L)	8	< 0.041	0.712	0.318	0.319	0.199	
Total Nitrogen (mg/L)	8	< 0.525	1.360	0.899	0.930	0.284	
Dissolved Reactive Phosphorus (mg/L)	8	0.015	0.096	0.070 ^M	0.060	0.034	
^J Total Phosphorus (mg/L)	8	0.041	0.130	0.107 ^M	0.091	0.039	
^J CBOD-5 (mg/L)	8	< 2.0	4.4	1.0	1.4	1.2	
Chlorides (mg/L)	8	3.5	6.9	5.2	4.9	1.1	
Total Metals							
^J Aluminum (mg/L)	4	0.095	0.465	0.182	0.231	0.166	
^J Iron (mg/L)	4	0.194	0.732	0.338	0.400	0.243	
^J Manganese (mg/L)	4	0.045	0.103	0.090	0.082	0.026	
Dissolved Metals							
^J Aluminum (mg/L)	4	< 0.043	0.067	0.022	0.033	0.023	
Antimony (µg/L)	4	< 3.6	< 3.6	1.8	1.8	0.0	
Arsenic (µg/L)	4	< 1.8	< 1.8	0.9	0.9	0.0	
Cadmium (µg/L)	4	< 0.022	< 0.046	0.017	0.017	0.007	
Chromium (mg/L)	4	< 0.009	< 0.009	0.004	0.004	0.000	
Copper (mg/L)	4	< 0.020	< 0.020	0.010	0.010	0.000	
^J Iron (mg/L)	4	< 0.019	0.105	0.052	0.054	0.041	
Lead (µg/L)	4	< 0.9	< 0.9	0.4	0.4	0.0	
^J Manganese (mg/L)	4	< 0.007	0.070	0.026	0.031	0.028	
Mercury (µg/L)	4	< 0.035	< 0.035	0.018	0.018	0.000	
Nickel (mg/L)	4	< 0.042	< 0.042	0.021	0.021	0.000	
Selenium (µg/L)	4	< 2.5	< 2.5	1.2	1.2	0.0	
Silver (µg/L)	4	< 0.015	0.215	0.058	0.058	0.058	
^J Thallium (µg/L)	4	< 1.4	1.8 ^H	0.7	1.0	0.6	1
Zinc (mg/L)	4	< 0.012	< 0.012	0.006	0.006	0.000	
Biological							
Chlorophyll a (ug/L)	8	0.80	16.02	7.56 ^M	7.31	5.80	
^J E. coli (col/100mL)	4	17	51	30	32	15	

E=# of exceedances; G=value higher than median concentration of all verified ecoregional reference reach data collected in the ecoregion 68; H=*F&W* human health criterion exceeded; J=estimate; M=value >90% of all verified ecoregional reference reach data collected in the ecoregion 68; 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.

Overall habitat quality was categorized as *marginal* for supporting macroinvertebrate communities, due to sedimentation and bank erosion in the reach. Benthic substrate at LFKJ-3 was mostly boulder, but sedimentation issues 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 LFKJ-3 indicated the aquatic insect community to be in *fair* condition. These results support the findings of a 2011 fish IBI survey conducted by GSA.

Water chemistry analyses showed that concentrations of dissolved thallium exceeded *F&W* human health criteria on one sampling date. Concentrations of total dissolved solids, hardness, alkalinity, dissolved reactive phosphorus, total phosphorus, and chlorophyll *a* were elevated as compared to data from ADEM's least-impaired reference reaches in ecoregion 68. Water temperature and specific conductance was also higher than expected for the area. DO and pH concentrations consistently met *F&W* criteria during the study period. Results of a 72-hour study showed diurnal changes in DO and pH were consistent with patterns observed in least-impaired reference reaches.

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