

2012 Monitoring Summary



Locust Fork at Warrior-Kimberly Road in Jefferson County (33.80931/-80075)

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 LFKB-8.

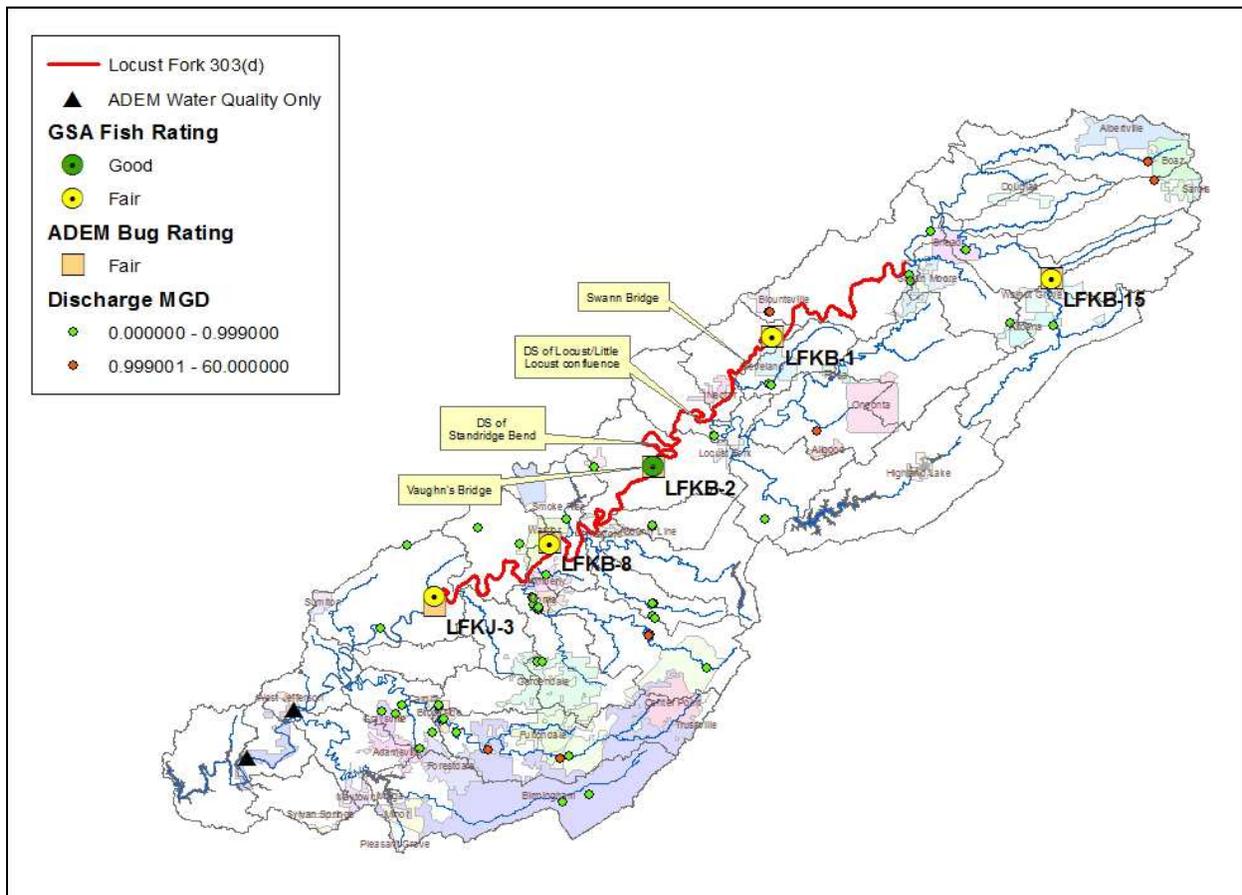


Figure 1. The locations of the five RSMP sampling stations on the mainstem of Locust Fork. The 303(d) listed segments of the Locust Fork are shown in red. Results of fish IBI surveys conducted by the Geological Survey of Alabama (GSA) and macroinvertebrate bioassessments conducted by ADEM are also shown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

WATERSHED CHARACTERISTICS

Watershed characteristics are summarized in Table 1. Locust Fork at LFKB-8 is classified as a *Public Water Supply (PWS)/Fish & Wildlife (F&W)* stream located in Jefferson County. Based on the 2006 National Land Cover Dataset, landuse within the watershed is predominantly forest (48%) and pasture land (Figure 2). About six percent of the area is developed. As of June 6, 2013, a total of 402 NPDES permits have been issued in the watershed, most of which are construction stormwater permits.

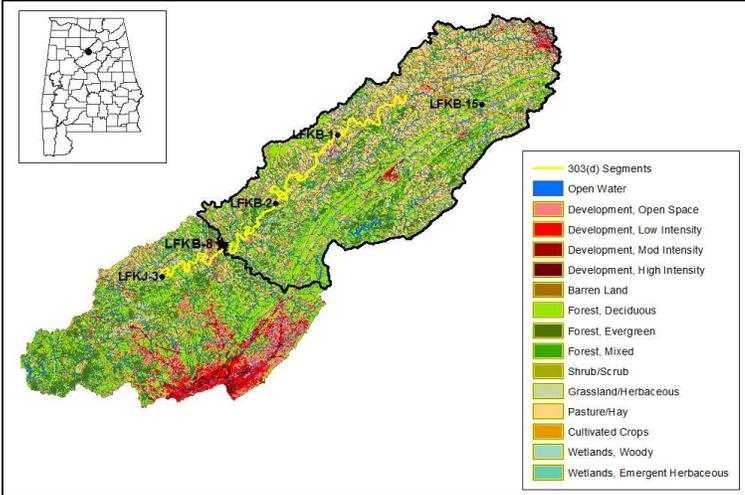


Figure 2. Sampling locations and landuse within the Locust Fork watershed. The 303 (d) listed segments of the Locust Fork are shown in yellow.

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 LFKB-8 is a glide-pool stream located in the Southern Limestone/Dolomite Valley and Low Rolling Hills (67f) ecoregion (Figure 3). Benthic substrate consists primarily of sand, with some gravel and bedrock. 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 sedimentation.



Figure 3. Locust Fork at LFKB-8, June 20, 2012.

Table 1. Summary of watershed characteristics.

| Watershed Characteristics | | Black Warrior River |
|---------------------------------------|---------------------|---------------------|
| Basin | | |
| Drainage Area (mi²) | | 707 |
| Ecoregion^a | | 67f |
| Ichthyoregion^b | | PLA |
| % Landuse | | |
| Open water | | 1 |
| Wetland | Woody | 1 |
| | Emergent herbaceous | <1 |
| Forest | Deciduous | 31 |
| | Evergreen | 10 |
| | Mixed | 7 |
| Shrub/scrub | | 5 |
| Grassland/herbaceous | | 3 |
| Pasture/hay | | 28 |
| Cultivated crops | | 6 |
| Development | Open space | 5 |
| | Low intensity | 1 |
| | Moderate intensity | <1 |
| | High intensity | <1 |
| Barren | | <1 |
| Population/km^{2c} | | 38 |
| # NPDES Permits^d | TOTAL | 402 |
| 401 Water Quality Certification | | 2 |
| Construction Stormwater | | 287 |
| Mining | | 36 |
| Industrial General | | 26 |
| Industrial Individual | | 7 |
| Municipal Individual | | 38 |
| Underground Injection Control | | 6 |

a. Southern Limestone/Dolomite Valleys and Low Rolling 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 LFKB-8, June 20, 2012.

| Physical Characteristics | | |
|--------------------------|---------|------|
| Width (ft) | | 100 |
| Canopy Cover | | Open |
| Depth (ft) | | |
| | Run | 2.0 |
| | Pool | 3.0 |
| % of Reach | | |
| | Run | 60 |
| | Pool | 40 |
| % Substrate | | |
| | Bedrock | 17 |
| | Boulder | 6 |
| | Gravel | 20 |
| | Sand | 57 |

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).

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. Arsenic concentrations exceeded human health criterion for fish and water consumption during one sampling event on September 12, 2012. Stream flow was normal at the time of sampling, but the site had experienced heavy rain within seven days prior to sample collection. Median concentrations of nitrate-nitrite nitrogen, total nitrogen, dissolved reactive phosphorus, total phosphorus, and chlorides were higher than expected for streams in the Southern Limestone/Dolomite Valleys and Low Rolling Hills ecoregion. Water temperature 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.

Dissolved oxygen (DO) and pH met *F&W* 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. DO, water temperature, pH, and conductivity were measured every fifteen minutes for 72 hours. Due to a probe malfunction, conductivity data was not validated and is not included in this report. Results of the study are shown in Figure 4. On average, DO in the water column changed approximately 3.0 mg/L in a diurnal cycle, slightly greater than patterns observed at least-disturbed reference reaches.

Table 3. Results of the habitat assessment conducted in Locust Fork at LFKB-8 on June 20, 2012.

| Habitat Assessment | % Maximum Score | Rating |
|---------------------------------|-----------------|----------------------------|
| NW | | |
| Instream Habitat Quality | 52 | Marginal (41-58) |
| Sediment Deposition | 63 | Sub-optimal (59-70) |
| Sinuosity | 75 | Sub-optimal (65-84) |
| Bank and Vegetative Stability | 55 | Marginal (35-59) |
| Riparian Buffer | 80 | Sub-optimal (70-90) |
| Habitat Assessment Score | 146 | |
| % Maximum Score | 61 | Sub-optimal (59-70) |

Table 4. Results of the macroinvertebrate bioassessment conducted in Locust Fork at LFKB-8 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 | 6 | 0 |
| % Nutrient tolerant organisms | 30 | 6 |
| % Tolerant taxa | 40 | 2 |
| WMB-I Assessment Score | --- | 12 |
| WMB-I Assessment Rating | | Fair (12-24) |

Table 5. Results of the fish IBI assessment conducted in Locust Fork at LFKB-8 on June 30, 2010 (GSA 2013).

| Fish IBI Assessment | Results | Score |
|---|---------|---------------------|
| Species richness and diversity | | |
| Total native species | 23 | 3 |
| Number cyprinid species | 6 | 1 |
| Number sucker species | 2 | 3 |
| Number <i>Lepomis</i> species | 3 | 1 |
| Number darter+madtom species | 5 | 3 |
| Tolerance and intolerance | | |
| Percent dominant species | 21 | 5 |
| Percent of tolerant species | 13 | 5 |
| Percent <i>Lepomis</i> | 9 | 5 |
| Trophic Measures | | |
| Percent omnivores | 27 | 3 |
| Percent carnivores | 3 | 3 |
| Abundance, condition, and reproduction | | |
| Percent DELT+hybrids | 0 | 5 |
| Percent simple lithophils | 37 | 3 |
| Total IBI Score | | 40 |
| IBI Assessment Rating | | Fair (33-40) |

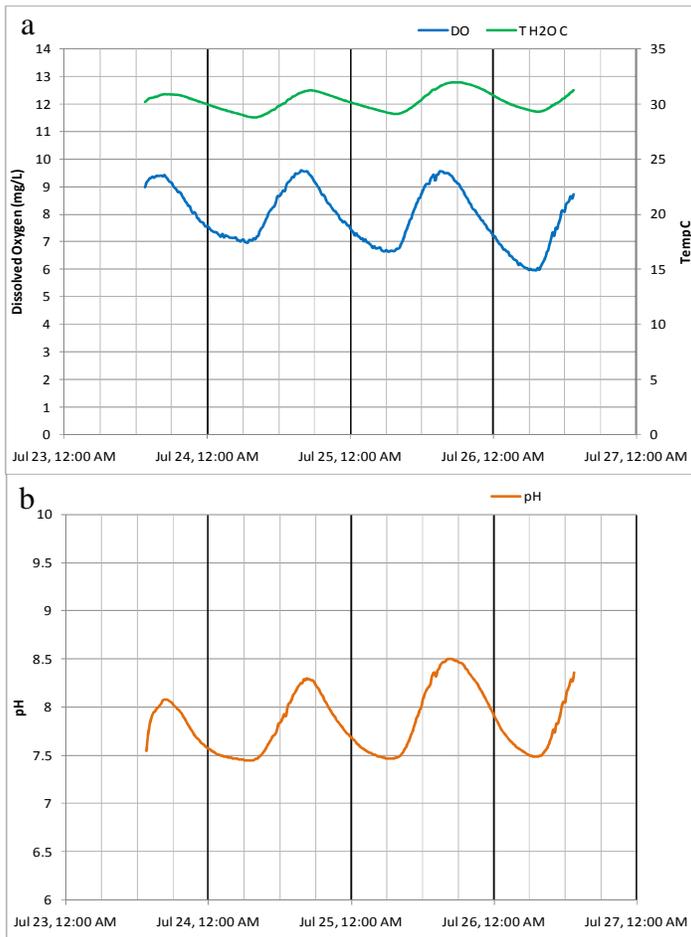


Figure 4. Results of 72-hour diurnal study conducted July 23-26, 2012. Lines indicate changes in DO and water temperature (a) and pH and conductivity (b) over time (courtesy of ADEM Water Quality).

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 and sedimentation were noted in the reach. Benthic substrate at LFKB-8 was mostly sand. Sand provides unstable habitat for macroinvertebrates, and sediment 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-8 indicated the aquatic insect community to be in *fair* condition. These results support the findings of a 2010 fish IBI survey conducted by the Geological Survey of Alabama (GSA).

Water chemistry analyses showed arsenic concentrations exceeded human health criterion for water and fish consumption on one sampling date. However, there was heavy rain in the area prior to sample collection. Water temperature and concentrations of nitrate-nitrite nitrogen, total nitrogen, dissolved reactive phosphorus, total phosphorus, and chlorides were also elevated as compared to data from ADEM's least-impaired reference reaches in ecoregion 67f. DO and pH concentrations consistently met *PWS/F&W* criteria during the study period. Results of a 72-hour study showed diurnal changes in DO that were slightly greater than patterns observed in least-impaired reference reaches.

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 | 9.9 | 27.9 | 25.5 ^M | 22.7 | 6.1 | |
| Turbidity (NTU) | 9 | 2.8 | 34.1 | 6.6 | 9.4 | 9.7 | |
| Total Dissolved Solids (mg/L) | 8 | 90.0 | 178.0 | 111.0 | 125.2 | 34.8 | |
| Total Suspended Solids (mg/L) | 8 | < 1.0 | 17.0 | 6.5 | 7.2 | 5.9 | |
| Specific Conductance (µmhos) | 9 | 102.4 | 221.8 | 183.8 | 179.8 | 39.9 | |
| Hardness (mg/L) | 4 | 68.1 | 88.0 | 78.8 | 78.4 | 10.1 | |
| Alkalinity (mg/L) | 8 | 42.2 | 79.9 | 58.0 | 60.2 | 13.5 | |
| Stream Flow (cfs) | 8 | 88.8 | 374.0 | 172.0 | 199.6 | 100.3 | |
| Chemical | | | | | | | |
| Dissolved Oxygen (mg/L) | 9 | 6.7 | 11.7 | 10.0 | 9.2 | 1.8 | |
| pH (su) | 9 | 6.7 | 8.4 | 7.8 | 7.6 | 0.5 | |
| Ammonia Nitrogen (mg/L) | 8 | < 0.007 | 0.055 | 0.004 | 0.013 | 0.019 | |
| Nitrate+Nitrite Nitrogen (mg/L) | 8 | < 0.002 | 1.500 | 0.656 ^M | 0.676 | 0.420 | |
| ^J Total Kjeldahl Nitrogen (mg/L) | 8 | 0.085 | 0.865 | 0.309 | 0.362 | 0.229 | |
| ^J Total Nitrogen (mg/L) | 8 | < 0.295 | 1.824 | 0.998 ^M | 1.038 | 0.447 | |
| Dissolved Reactive Phosphorus (mg/L) | 8 | 0.041 | 0.234 | 0.110 ^M | 0.111 | 0.062 | |
| Total Phosphorus (mg/L) | 8 | 0.063 | 0.251 | 0.158 ^M | 0.150 | 0.061 | |
| ^J CBOD-5 (mg/L) | 8 | < 2.0 | < 2.0 | 1.0 | 1.0 | 0.0 | |
| Chlorides (mg/L) | 8 | 3.2 | 9.0 | 5.2 ^M | 5.5 | 2.0 | |
| Total Metals | | | | | | | |
| ^J Aluminum (mg/L) | 4 | 0.058 | 0.278 | 0.140 | 0.154 | 0.095 | |
| ^J Iron (mg/L) | 4 | 0.122 | 0.418 | 0.252 | 0.261 | 0.124 | |
| ^J Manganese (mg/L) | 4 | 0.026 | 0.079 | 0.047 | 0.050 | 0.026 | |
| Dissolved Metals | | | | | | | |
| Aluminum (mg/L) | 4 | < 0.043 | < 0.043 | 0.022 | 0.022 | 0.000 | |
| Antimony (µg/L) | 4 | < 3.6 | < 3.6 | 1.8 | 1.8 | 0.0 | |
| ^J Arsenic (µg/L) | 4 | < 1.8 | 2.0 ^H | 0.9 | 1.2 | 0.6 | 1 |
| Cadmium (µg/L) | 4 | < 0.022 | < 0.046 | 0.023 | 0.020 | 0.006 | |
| 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 | 0.078 | 0.051 | 0.047 | 0.028 | |
| Lead (µg/L) | 4 | < 0.9 | < 0.9 | 0.4 | 0.4 | 0.0 | |
| ^J Manganese (mg/L) | 4 | < 0.007 | 0.035 | 0.024 | 0.021 | 0.015 | |
| 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 | |
| ^J Silver (µg/L) | 4 | < 0.015 | 0.216 | 0.108 | 0.110 | 0.085 | |
| Thallium (µg/L) | 4 | < 1.4 | < 1.4 | 0.7 | 0.7 | 0.0 | |
| Zinc (mg/L) | 4 | < 0.012 | < 0.012 | 0.006 | 0.006 | 0.000 | |
| Biological | | | | | | | |
| Chlorophyll a (ug/L) | 8 | 0.36 | 29.90 | 1.60 | 5.37 | 10.00 | |
| ^J E. coli (col/100mL) | 4 | 26 | 291 | 89 | 124 | 117 | |

E=# of samples that exceeded criteria; H=PWS/F&W human health criterion exceeded; J=estimate; M=value >90% of all verified ecoregional reference reach data collected in the ecoregion 67f; N=# samples.

FOR MORE INFORMATION, CONTACT:
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