

2013 Monitoring Summary



Basin Assessment Site

Mack Creek at unnamed road near Lebanon Church

BACKGROUND

The Alabama Department Environmental Management (ADEM) selected the Mack Creek watershed for biological and water quality monitoring as part of the 2013 assessment of the Tennessee River Basins. The objectives of the Tennessee Basin Assessments were to assess the biological integrity of each monitoring site and to estimate overall water quality within the basin group.



Figure 1. Mack Creek at MACM-330, May 15, 2013.

WATERSHED CHARACTERISTICS

Watershed characteristics are summarized in Table 1. Mack Creek is a *Fish & Wildlife (F&W)* stream located in the Eastern Highland Rim ecoregion (71g). Based on the 2000 National Land Cover Dataset, about 44% of the watershed is pasture/hay. Forest accounted for 37% of the land cover in the area. As of May 13, 2013, a total of 2 NPDES permits have been issued in the watershed.

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. Mack Creek at MACM-330 is a low-gradient, glide-pool stream located in the Tennessee River Basin (Figure 1). Habitat quality and availability was categorized as *marginal* due to lack of channelization and loss of riparian buffer.

BIOASSESSMENT RESULTS

Benthic macroinvertebrate communities were sampled using ADEM's Intensive Multi-habitat Bioassessment methodology (WMB-I). The WMB-I uses measures of taxonomic richness, community composition, and community tolerance to assess the overall health of the macroinvertebrate community. Each metric is scored on a 100 point scale. The final score is the average of all individual metric scores. Metric results indicated the macroinvertebrate community to be in *poor* condition (Table 4).

Table 1. Summary of watershed characteristics.

Watershed Characteristics		
Basin	Tennessee River	
Drainage Area (mi ²)	6	
Ecoregion ^a	71g	
% Landuse		
Open water	<1	
Wetland	Woody	3
Forest	Deciduous	27
	Evergreen	3
	Mixed	7
Shrub/scrub	3	
Grassland/herbaceous	3	
Pasture/hay	44	
Cultivated crops	5	
Development	Open space	3
	Low intensity	<1
Barren	1	
Population/km ^{2b}	15	
# NPDES Permits ^c	TOTAL	
	Mining	1
	Industrial General	1

a. Eastern Highland Rim

b. 2000 US Census

c. #NPDES permits downloaded from ADEM's NPDES Management System database, May 13, 2013.

Table 2. Physical characteristics of Mack Creek at MACM-330, June 13, 2013.

Physical Characteristics		
Width (ft)	20	
Canopy Cover	Estimate 50/50	
Depth (ft)	Run	1.0
	Pool	2.0
% of Reach	Run	75
	Pool	25
% Substrate	Clay	5
	Gravel	12
	Hard Pan Clay	60
	Sand	5
	Silt	5
	Organic Matter	13

Table 3. Results of the habitat assessment conducted on Mack Creek at MACM-330, June 13, 2013.

Habitat Assessment	%Maximum Score	Rating
Instream Habitat Quality	54	Marginal (41-58)
Sediment Deposition	58	Marginal (41-58)
Sinuosity	43	Poor (<45)
Bank and Vegetative Stability	43	Marginal (35-59)
Riparian Buffer	35	Poor (<50)
Habitat Assessment Score	111	
% Maximum Score	50	Marginal (41-58)

Table 4. Results of the macroinvertebrate bioassessment conducted in Mack Creek at MACM-330, June 13, 2013.

Macroinvertebrate Assessment		
	Results	Scores (0-100)
Taxa richness and diversity measures		
# EPT taxa	6	9
Shannon Diversity	3.55	40
Taxonomic composition measures		
% EPT minus Baetidae and Hydropsychidae	10	20
% Non-insect taxa	21	7
Functional feeding group		
% Predator Individuals	9	34
Community tolerance		
% Tolerant taxa	43	17
WMB-I Assessment Score	---	21
WMB-I Assessment Rating		Poor (15-28)

WATER CHEMISTRY

Results of water chemistry samples are presented in Table 5. In situ measurements and water samples were collected monthly, semi-monthly (metals), or quarterly (pesticides, herbicides (atrazine), and semi-volatile organics) during March through September of 2013 to help identify any stressors to the biological communities. Arsenic and chromium both had two uncertain exceedances. Although samples of total dissolved arsenic did exceed human health criteria in Mack Creek, ADEM criteria for arsenic are expressed as dissolved trivalent arsenic (arsenite – As III). Presently studies are being conducted in order to provide a better understanding of the prevalence and areal distribution of dissolved trivalent arsenic to total arsenic in the State of Alabama. Upon conclusion of the studies Mack Creek will be reassessed for arsenic violations.

Median concentrations of specific conductance, hardness, total dissolved solids, chlorides, aluminum, iron, manganese and alkalinity were higher than values expected based on data collected at reference reaches within the Interior Plateau ecoregion (71). Eastern Highland Rim ecoregion (71g) is a level IV ecoregion within the level III Interior Plateau ecoregion (71).

SUMMARY

Results of ADEM's 2013 macroinvertebrate bioassessment indicated the macroinvertebrate community to be in *poor* condition. Mack Creek at MACM-330 had some sedimentation and a poor riparian buffer quality, resulting in an *marginal* habitat quality score. However, intensive water chemistry results indicated median concentrations of physical, chemical, and dissolved metals parameters were higher than expected for streams within the reach.

Table 5. Summary of water quality data collected March-September, 2013. 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	Q
Physical							
Temperature (°C)	6	9.9	24.3	21.0	19.5	5.4	
Turbidity (NTU)	5	4.0	14.2	8.3	8.7	3.6	
Total Dissolved Solids (mg/L)	4	158.0	203.0	174.0 ^M	177.2	22.0	
Total Suspended Solids (mg/L)	4	< 1.0	6.0	1.8	2.5	2.6	
Specific Conductance (µmhos)	6	245.5	396.8	311.5 ^G	311.4	52.1	
Hardness (mg/L)	4	112.0	158.0	137.0 ^G	136.0	19.0	
Alkalinity (mg/L)	4	111.0	143.0	125.7 ^M	126.4	14.2	
Stream Flow (cfs)	5	0.8	8.8	1.6	3.4	3.4	
Chemical							
Dissolved Oxygen (mg/L)	6	6.9	11.4	7.6	8.3	1.6	
pH (su)	6	7.2	7.8	7.6	7.6	0.2	
^J Ammonia Nitrogen (mg/L)	4	< 0.008	< 0.018	0.009	0.010	0.005	
Nitrate+Nitrite Nitrogen (mg/L)	4	0.143	0.308	0.268	0.247	0.074	
Total Kjeldahl Nitrogen (mg/L)	4	0.155	0.361	0.266	0.262	0.097	
Total Nitrogen (mg/L)	4	0.350	0.633	0.526	0.509	0.134	
^J Dissolved Reactive Phosphorus (mg/L)	4	0.006	0.033	0.012	0.016	0.012	
Total Phosphorus (mg/L)	4	0.015	0.055	0.024	0.030	0.018	
CBOD-5 (mg/L)	4	< 2.0	< 2.0	1.0	1.0	0.0	
Chlorides (mg/L)	4	2.5	3.2	2.7 ^M	2.8	0.3	
Atrazine (µg/L)	2	0.14	0.14	0.14	0.14	0.00	
Total Metals							
^J Aluminum (mg/L)	4	0.089	0.292	0.270	0.230	0.095	
Iron (mg/L)	4	0.211	0.390	0.309	0.305	0.074	
^J Manganese (mg/L)	4	0.038	0.063	0.049	0.050	0.012	
Dissolved Metals							
Aluminum (mg/L)	4	< 0.076	< 0.076	0.038 ^M	0.038	0.000	
Antimony (µg/L)	4	< 0.1	2.6	0.7	0.7	0.7	
^J Arsenic (µg/L)	4	0.7	< 1.4 ^H	0.7	0.9	0.3	2
^J Cadmium (µg/L)	4	< 0.046	< 0.170	0.066	0.060	0.030	
^J Chromium (µg/L)	4	0.878	< 32.000 ^S	8.710	8.574	8.577	2
^J Copper (mg/L)	4	0.001	< 0.031	0.008	0.008	0.008	
^J Iron (mg/L)	4	< 0.018	0.130	0.075 ^M	0.072	0.050	
Lead (µg/L)	4	< 0.1	< 1.1	0.3	0.3	0.3	
^J Manganese (mg/L)	4	0.033	0.052	0.043 ^M	0.043	0.009	
Mercury (µg/L)	2	< 0.057	< 0.057	0.028	0.028	0.000	
^J Nickel (mg/L)	4	0.0003	< 0.016	0.004	0.004	0.004	
Selenium (µg/L)	4	< 0.2	< 1.4	0.4	0.4	0.3	
Silver (µg/L)	4	< 0.215	< 2.120	0.584	0.584	0.550	
Thallium (µg/L)	4	< 0.1	< 1.1	0.3	0.3	0.3	
^J Zinc (mg/L)	4	0.003	< 0.017	0.006	0.006	0.003	
Biological							
Chlorophyll a (ug/L)	4	0.36	5.34	0.80	1.82	2.36	
E. coli (col/100mL)	4	167	980	295	434	373	

J=estimate; N=# samples; G=value greater than median concentration of all verified reference data collected in ecoregion 71; M=value >90% of all verified ecoregional reference reach data collected in the ecoregion 71. H=F&W human health criterion exceeded; S=F&W hardness-adjusted aquatic life use criteria exceeded; Q=uncertain exceedance.

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