

Trend Monitoring Summary: 1996-2009

Crowdabout Creek at Hopewell Road (Morgan County; 34.39282/-87.02805)

BACKGROUND

The 15.0 mile segment of Crowdabout Creek from Flint Creek to its source was placed on Alabama's 1996 Clean Water Act (CWA) §303(d) list of impaired waters for not meeting its *Fish & Wildlife (F&W)* water use classification criteria. In 1998, the reach was listed for impairments caused by siltation, pathogens, and organic enrichment/low dissolved oxygen concentrations (OE/DO) from non-irrigated crop production, pasture grazing, and animal holding/management areas.

The Alabama Department of Environmental Management (ADEM) developed a Total Maximum Daily Load (TMDL) to decrease the sediment load of 22 stream segments within the Lower Tennessee River Basin, including Crowdabout Creek. A second TMDL was developed to address the OE/DO and pathogen impairments within Crowdabout Creek and 16 other impaired stream segments within the Flint Creek watershed. Both TMDLs were approved by US Environmental Protection Agency Region 4 (USEPA) in 2003.

Implementation of best management practices (BMPs) to address these issues began in October of 2004. In 2006, a watershed management plan (WMP) was developed to more specifically document how BMPs would be implemented to help address the agricultural sources of siltation, pathogens, and organic enrichment identified in the two TMDLs. The BMPs and WMP were implemented in part using a Clean Water Act (CWA) §319(h) nonpoint source grant provided by USEPA through ADEM's §319 grant program. Between December of 2005 and March of 2009, 1372 acres of riparian forest buffers were planted throughout the Crowdabout Creek watershed (Figure 1). Figures 2-6 show stream reaches within the Crowdabout Creek watershed in 2006, before most of the riparian forest buffers were planted, and in 2011, three years after the project was fully implemented.

In June of 2009, the ADEM conducted habitat and macroinvertebrate assessments and intensive water quality sampling in Crowdabout Creek at CRDM-1 to document current water quality conditions and to evaluate the effectiveness of BMPs implemented in the Crowdabout Creek watershed.

WATERSHED CHARACTERISTICS

Typical of many watersheds located in the Eastern Highland Rim (71g) subcoregion of the Interior Plateau, the Crowdabout Creek watershed is flat and frequently flooded. Approximately ninety percent of the watershed is located in Morgan County. Crowdabout Creek at CRDM-1 is a second order stream draining approximately 34 mi².

Table 1 summarizes land cover within the Crowdabout Creek watershed based on the 1993 and 2006 National Land Cover Datasets (NLCD). Both datasets are included in Table 1 and Figure 1 because they coincide with ADEM's 1996 and 2009 macroinvertebrate assessments. Although detailed NLCD categories differ, comparison of the two datasets show trends in land usage throughout the watershed. Since 1993, percent wetland, forest, and crop cover have decreased while percent pasture/hay, shrub/scrub/other grasses, and urban areas have increased.

As part of the WMP, a total of 1,372 acres of riparian buffer was established throughout the watershed, concentrating on areas within 300 feet of Crowdabout Creek and its tributaries. In the 2006 map, Figure 1 shows the location of the forest buffer zones planted to decrease sediment and nutrient loading into Crowdabout Creek.

Table 1. Comparison of watershed characteristics between 1993 and 2006 based on the National Land Cover Datasets (NLCD).

Watershed Characteristics			
NLCD		1993	2006
% Landuse			
Open water		<1	<1
Wetland	Total	8	4
	Woody	7	4
	Herbaceous	1	<1
Forest	Total	48	39
	Deciduous	29	26
	Evergreen	6	6
	Mixed	13	7
Other grasses/shrub/scrub		1	6
Pasture/hay		32	42
Cultivated crops		12	4
Development		<1	4

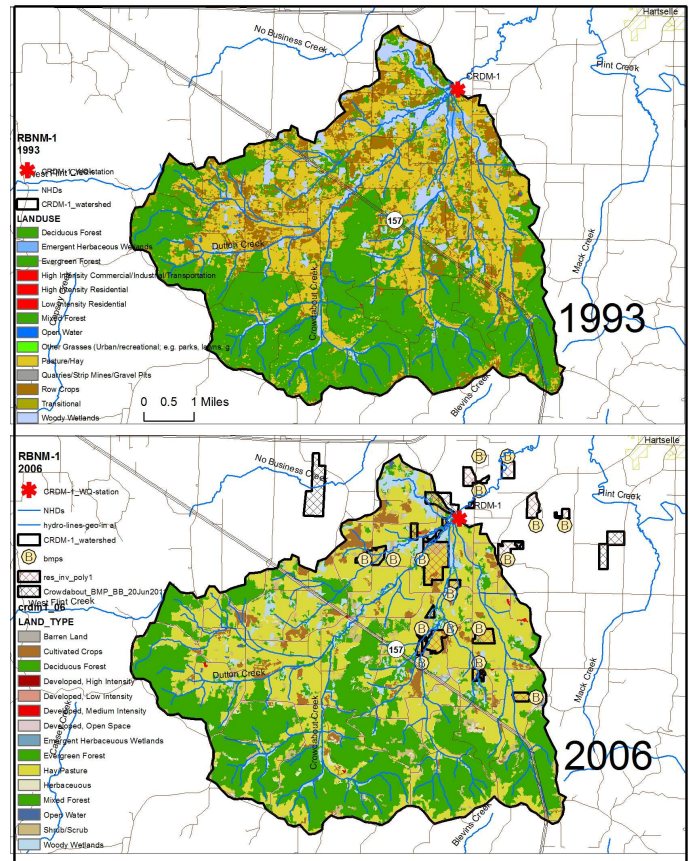


Figure 1. Land cover within the CRDM-1 watershed based on the 1993 and 2006 NLCDs. The 1993 map shows landuse within the watershed prior to TVA's 1994 and 1995 bioassessments; the 2006 map represents conditions when the watershed management plan was developed. The location of BMPs installed 2006-2011 is also shown.



Figure 2a. Site in the Herrin Creek watershed, a tributary to Crowdabout Creek, in 2006.



Figure 2b. Same location in 2011 after best management practices were implemented.



Figure 3a. Site in the Herrin Creek watershed, a tributary to Crowdabout Creek, in 2006.



Figure 3b. Same location in 2011 after best management practices were implemented.



Figure 4a. Site in Herrin Creek watershed, a tributary to Crowdabout Creek, in 2006.



Figure 4b. Same location in 2011 after best management practices were implemented.

REACH CHARACTERISTICS

ADEM completed general observations (Table 2) and habitat assessments (Table 3) during the 1996 and 2009 macroinvertebrate assessments. 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. In both 1996 and 2009, substrates within the reach were dominated by clay, but percent silt was lower in 2009. Scores for instream habitat quality and riparian zone measurements both improved in 2009, and the overall habitat assessment rating improved from *poor* to *fair*.

Table 2. Summary of physical characteristics observed at CRDM-1, May 7, 1996 and June 2, 2009.

Physical Characteristics			
Date (m/d/yyyy)	5/9/1996	6/2/2009	
Width (ft)	21	15	
Canopy Cover	Open	Mostly shaded	
Depth (ft)	Run	2.3	1.5
	Pool	0	1.0
% of Substrate	Clay	75	80
	Gravel	1	2
	Sand	10	10
	Silt	12	3
	Organic Matter	2	5

MACROINVERTEBRATE BIOASSESSMENTS

ADEM sampled the benthic macroinvertebrate community using ADEM's Intensive Multi-habitat Bioassessment Methodology (WMB-I) in 1996 and 2009 (Table 4). The WMB-I uses measures of taxonomic richness, community composition, and community tolerance to assess the overall health of the macroinvertebrate community.

Although slight, most metrics indicated an improvement in biological community conditions. The number and percent of pollution-sensitive EPT taxa increased between 1996 and 2009. Results showed a slight increase in diversity and a decrease in the relative number of tolerant taxa.

Table 4. Results of macroinvertebrate bioassessments of Crowabout Creek at CRDM-1 conducted May 7, 1996 and June 2, 2009.

Macroinvertebrate Assessment Results				
	5/9/1996	6/2/2009	Metric	Interpretation as
	Results	Results		water quality improves:
Taxa richness measures				
# EPT genera	11	12		Increases
Shannon Diversity	3.83	3.96		Increases
Taxonomic composition measures				
% EPT Individuals—				
Baetidae and Hydropsychidae	6	20		Increases
% Non-insect taxa	20	23		Decreases
Functional composition measures				
% Predators	11	10		Increases
Tolerance measures				
% Taxa as tolerant	45	38		Decreases

Table 3. Results of habitat assessments conducted at CRDM-1, May 7, 1996 and June 2, 2009.

Habitat Assessment	5/7/1996	6/2/2009
	% Maximum Score	% Maximum Score
Instream habitat quality	26	39
Sediment deposition	49	50
Sinuosity	13	28
Bank and vegetative stability	66	44
Riparian buffer	21	71
Habitat assessment score	88	103
% Maximum score	40	47
Habitat Assessment Rating	Poor	Fair

WATER CHEMISTRY

Table 5 summarizes water quality data collected in Crowabout Creek in 1996 and 2009. The 1996 data was collected by the Geological Survey of Alabama (GSA) at New Cut Road, approximately 0.6 river miles upstream of CRDM-1. Data were collected monthly, January 1995-December 1997 at several locations throughout the Flint Creek watershed as part of GSA's Flint Creek Nonpoint Source Project, which was funded in part through ADEM's §319 grant program. The 1996 data were used to coincide with ADEM's 1996 habitat and macroinvertebrate assessments.

In 2009, in situ measurements and water samples were collected monthly, March through October at CRDM-1. However, nutrient samples collected March-July (ammonia nitrogen, total Kjeldahl nitrogen (TKN), total nitrogen, and total phosphorus) were excluded from analyses because they did not meet ADEM's laboratory quality control requirements. For comparison purposes, the medians of these parameters were calculated using only the August-October 1996 sample results to coincide with ADEM's 2009 sample results.

Comparison of the 1996 and 2009 data show that turbidity and median concentrations of total suspended solids, total dissolved solids, nitrogen as ammonium, nitrate+nitrite nitrogen, CBOD-5, and specific conductance decreased in 2009, suggesting improved water quality conditions. Dissolved oxygen concentrations also improved. However, median total nitrogen, total Kjeldahl nitrogen (TKN), and total phosphorus were higher in 2009 than in 1996.

Table 5. Summary of water quality data collected by GSA in 1996 and by ADEM in 2009. The 1996 samples were collected from a stream reach approximately 0.6 stream miles upstream of CRDM-1.

Parameter	Basis of Comparison	GSA 1996	CRDM-1 2009
Temperature (°C)	Max	25	24.3
Turbidity (NTU)	Max	130	71.4
Total Dissolved Solids (mg/L)	Median	187	140.0
Total Suspended Solids (mg/L)	Median	37	13.5
Specific Conductance (µmhos)	Median	262	238.0
Stream Flow (cfs)	Min	1	2.4
Dissolved Oxygen (mg/L)	Min	0.7	6.0
Ammonia Nitrogen (mg/L)	Median	0.12	0.003
Nitrate+Nitrite Nitrogen (mg/L)	Median	0.513	0.213
Total Kjeldahl Nitrogen (mg/L)	Median	0.74	1.134
Total Phosphorus (mg/L)	Median	0.04	0.275
CBOD-5 (mg/L)	Median	1.3	0.5

SUMMARY

The 15.0 mile segment of Crowabout Creek from Flint Creek to its source was placed on Alabama's 1996 CWA §303(d) list of impaired waters for not meeting its *F&W* water use classification criteria. In 1998, the reach was listed for impairments caused by siltation, pathogens, and organic enrichment/low dissolved oxygen concentrations (OE/DO) from non-irrigated crop production, pasture grazing, and animal holding/management areas.

Two separate TMDLs were developed to decrease siltation and organic enrichment within Crowabout Creek and other streams within the Tennessee River basin. Riparian forest buffers and other BMPs were implemented between October of 2004 and March of 2009 to address the agricultural sources of siltation, pathogens, and organic enrichment identified in the two TMDLs. Comparison of 1993 and 2006 land cover data show an increase in percent pasture/hay and urban development within the watershed.

In 2009, the ADEM conducted habitat and macroinvertebrate assessments and intensive water quality sampling in Crowabout Creek to document current water quality conditions and to evaluate the effectiveness of BMPs implemented in the Crowabout Creek watershed. Although slight, comparison of data collected by GSA and ADEM since 1996 suggest that the forest riparian buffers and other implemented BMPs are decreasing siltation loads, improving in-stream habitat, as well as water quality conditions. Biological conditions showed a slight improvement, but the 2009 assessment was conducted only six months after the final BMP was implemented. In addition, percent pasture/hay and development have increased throughout the watershed.

Monitoring and BMP implementation should continue to document trends in habitat, biological, and water quality conditions as the riparian forests and other BMPs become more established.

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