STREAM ECOSUMMARY

Crooked Creek
WBID 504, Gadsden County
August 15, 2017 and January 21, 2020



Figure 1. Sampling reach along Crooked Creek in Gadsden County.

Physical, chemical, and biological sampling was conducted at Crooked Creek (STORET/WIN 31010050, SBIO Crk*Ref) in Gadsden County on August 15, 2017 and January 21, 2020 by the DEP, Division of Environmental Assessment and Restoration (DEAR), Aquatic Ecology and Quality Assurance Section (AEQAS). This stream was sampled as part of the DEP Ecoregional Reference Stream survey, which was designed to provide baseline information about the state's highest quality streams and monitor the water quality and biological community health of these streams through time. Overall, the water quality and macroinvertebrate community data indicated that the stream met expectations for a healthy, well-balanced stream.

Background

Healthy, well-balanced stream and river communities may be maintained with some level of human activity, but excessive human disturbance may result in waterbody degradation. Human stressors may include increased inputs of nutrients, sediments, and/or other contaminants from watershed runoff, adverse hydrologic alterations, undesirable removal of habitat or riparian buffer vegetation, and introduction of nuisance (generally exotic) plants and animals. DEP evaluates if human activities have resulted in the condition where a waterbody has exceeded water quality criteria (Chapter 62-302, Florida Administrative Code), including whether adverse impacts to biological communities have occurred. DEP water quality standards are designed to protect designated uses of the waters of the state (*e.g.,* recreation, aquatic life use support), and exceedances of these standards is associated with interference with the designated use. Additionally, DEP evaluates the health of floral (plants and algae) and faunal (animal) communities and conducts habitat assessments to diagnose potential physical impacts.

Site Description

The Crooked Creek sampling location (Figure 1) is located west of Greensboro, FL, approximately 0.15 miles from the Liberty-Gadsden County border (Figure 2). It is a third order stream in the Apalachicola-Chipola Basin draining the Dougherty/Marianna Plains, a subecoregion of the Southern Coastal Plain ecoregion. Crooked Creek flows into the Apalachicola River and has a Landscape Development Intensity (LDI) Index score of 1.2. The LDI quantifies the intensity of human activity in the surrounding area based on land use and land cover and is normalized on a scale from 1 to 10, where a natural land use has a coefficient of 1.0 and a central business district has a coefficient of 10.0. This site's

score of 1.2 suggests minimal human activity in the 100m buffer surrounding the stream. The WBID is not currently listed for any parameters on the Verified List of Impaired Waters. Additional information about this WBID is available in the Water Quality Assessments, TMDLs, and BMAPs map application (https://fdep.maps.arcgis.com/home/webmap/viewer.html?webmap=1b4f1bf4c9c3481fb2864a415fbeca77)

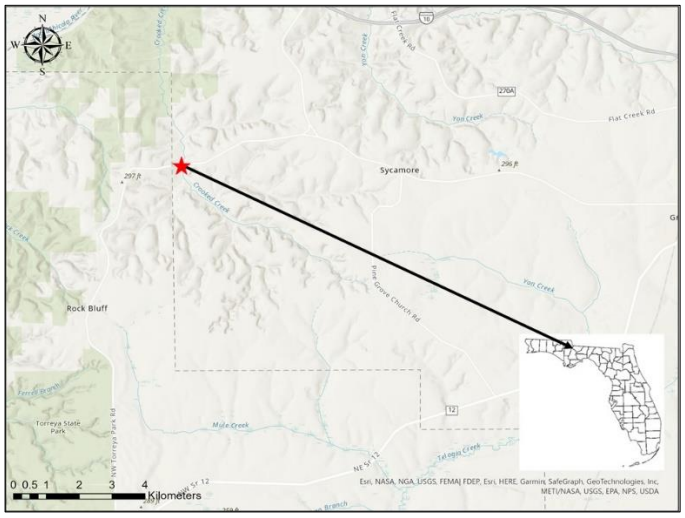


Figure 2. Location of Crooked Creek sampling location in Gadsden County.

Methods

Water Quality

Surface water samples were collected for analysis of alkalinity, turbidity, chloride, color, fluoride, sulfate, total dissolved solids, total suspended solids, nutrients, chlorophyll, *Escherichia coli* (*E. coli*), pesticides, herbicides, sucralose, and metals following DEP Standard Operating Procedures (SOPs, see https://floridadep.gov/dear/quality-assurance/content/dep-sops for details) and met the requirements of the FDEP Quality Assurance Rule, Chapter 62-160, F.A.C. (https://www.flrules.org/gateway/ChapterHome.asp?Chapter=62-160). Results were compared with applicable Class III water quality criteria contained in 62-302, F.A.C., including nutrients, dissolved oxygen, and other indicators.

Chapter 62-302.531, F.A.C., provides that Numeric Nutrient Criteria (NNC) are achieved in streams if: Information on chlorophyll *a* levels, algal mats or blooms, nuisance macrophyte growth, and changes in algal species composition do not indicate an imbalance in flora or fauna; AND EITHER

The average score of at least two temporally independent Stream Condition Indices (SCIs) is 40 or higher, with neither of the two most recent SCI scores less than 35, OR

The nutrient thresholds (expressed as annual geometric means) are not exceeded more than once in a three-year period. The nutrient thresholds are region-specific. This sampling site is in the Panhandle West nutrient region. The floral and faunal measures are described below.

Dissolved Oxygen

Rule 62-302.533 (1), F.A.C., states that no more than 10 percent of the daily average percent dissolved oxygen (DO) saturation values shall be below 67 percent in the Panhandle West bioregion, 38 percent in the Peninsula and Everglades bioregions, or 34 percent in the Northeast and Big Bend bioregions. This site is in the Panhandle region for DO criteria assessment. Percent saturation takes into account factors such as temperature, atmospheric pressure, and salinity.

The daily average freshwater DO criteria is preferentially assessed using daily average values calculated from full days of diel (collected over a 24 hour period) monitoring data. If diel monitoring data are not available (as was the case for this report), instantaneous samples are used to assess the DO criterion by comparing the instantaeous value with a time-of-day-specific translation of the daily average criterion (62-303.420(9), F.A.C.).

Habitat Assessment

The Stream and River Habitat Assessment was conducted per DEP SOP FT 3100. The Habitat Assessment is a rapid field method in which a sampler scores eight in-stream and riparian components to estimate the influence of habitat factors on the resident aquatic organisms. Habitat Assessment scores range from 11-160 and overall habitat quality is assigned to one of four categories: Optimal (120-

160 points), Suboptimal (80-119 points), Marginal (40-79 points), and Poor (11-39 points).

Floral Assessment

Evaluations of stream flora include the Rapid Periphyton Survey (RPS, DEP SOP FS 7230), community composition information associated with dominant algal taxa (where applicable), Linear Vegetation Survey (LVS, DEP SOP 7320), and chlorophyll *a*. The RPS assesses the extent and thickness of algae in the stream reach, while the LVS assesses how closely the in-stream plant community resembles a minimally disturbed condition. Results are assessed as described beginning on page 8 of "*Implementation of Florida's Numeric Nutrient Standards*," dated April 2013, using evidentiary thresholds derived from a population of minimally disturbed reference sites.

Faunal Assessment

The Stream Condition Index (SCI) assesses how closely the macroinvertebrate community (*e.g.*, aquatic insects, clams, crayfish) of a stream resembles the macroinvertebrate community of an undisturbed or "reference" condition. The SCI was sampled and calculated per DEP SOP SCI 1000. For the SCI, ten measures of macroinvertebrate health are calculated and summed to yield a final score from 0-100. Average SCI scores ≥ 40 are considered "Healthy" (as long as neither of the latest two SCI scores were < 35) with scores ≥ 64 considered "Exceptional." The SCI is part of the NNC evaluation for streams, as described above, and also serves as a biological health assessment tool in 62-303, F.A.C., DEP's Impaired Waters Rule.

Evaluation of Stream Exclusions for Applying Nutrient Criteria

When assessing a stream for compliance with NNC in Rule 62-302.531, F.A.C., it is important to note that several waterbody types are excluded from the stream definition in Rule 62-302.200(36), F.A.C. These include lake-like portions of rivers (where the lake NNC apply) and ditches/canals used for water management purposes, non-perennial streams, wetlands, and tidally fluctuating areas (where the narrative criterion, "no imbalances in natural populations of aquatic flora or fauna," continues to apply). The NNC in Rule 62-302.531, F.A.C., were applicable to Crooked Creek.

Results

Water Quality

The water quality results are shown in Table 1. Dissolved oxygen field measurements in 2017 and pH measurements in 2020 were marked as estimated using the "J" qualifier code because the continuing calibration verification for these parameters failed.

Alkalinity results were 4.0 mg $CaCO_3$/L and 6.2 mg $CaCO_3$/L for each sampling event, respectively. The water quality standard for alkalinity is that values shall not be depressed below 20 mg $CaCO_3$/L. However, in 2015, alkalinity at Crooked Creek was 3.9 mg $CaCO_3$/L. Thus, while 4.0 and 6.2 mg $CaCO_3$/L are below the water quality standard value of 20 mg $CaCO_3$/L, the system's historic levels indicate alkalinity values below 20 mg $CaCO_3$/L are likely due to natural conditions.

The water quality standard for total phosphorus for the Panhandle West nutrient region is 0.06 mg/L. Total phosphorus results were 0.21 mg/L (2017) and 0.14 mg/L (2020), and thus exceeded the water quality standard for total phosphorus.

Eschericha coli (*E. coli*) was collected in 2020, but not in 2017. The water quality standard for *E. coli* is 410 count/100 mL. In 2020, *E. coli* results were 547.5 MPN/100 mL, and thus exceeded the water quality standard for *E. coli.* However, the Q qualifier was associated with the 2020 *E. coli* sample indicating that the sample did not meet required holding times. Additional sampling is needed to determine if the *E. coli* exceedance is representative of the water body or if the holding time exceedance contributed to the *E. coli* results observed in 2020.

NNC Threshold Assessment

Based on these two sampling events, Crooked Creek exceeded the numeric nutrient thresholds for total phosphorus but met the numeric nutrient thresholds for total nitrogen for the Panhandle West; however,

the thresholds represent annual geometric mean concentrations (minimum of four samples) not to be exceeded more than once in any three-calendar year period and are used in combination with floral and faunal information. Therefore, even though the thresholds were exceeded for total phosphorus but met thresholds for total nitrogen, additional nutrient sampling may be needed to meet data sufficiency requirements to calculate and assess attainment of the water quality standard.

Floral Assessment

Results of the floral metrics show that this site is within the reference stream distribution and therefore attains the floral component of the NNC (Table 2). No algae or aquatic plants were observed during either sampling event. In 2017, chlorophyll *a* was below the floral thresholds (2.7 ug/L), but in 2020 was measured at 6.8 ug/L which was above the floral threshold for chlorophyll *a*. However, the thresholds represent annual geometric mean concentrations (minimum of four samples) not to be exceeded more than once in any three-calendar year period. Additionally, floral thresholds for chlorophyll *a* indicate that if values are between 3.2 ug/L and 20 ug/L than site-specific evaluation should be conducted. Additional chlorophyll sampling may be needed to meet sufficiency requirements to calculate and assess attainment of the water quality standard.

Table 1. Water quality results from August 15, 2017 and January 21, 2020 at Crooked Creek.

Analyte	Result 8/15/2017	Result 1/21/2020	Applicable Class III Water Quality Criteria
Field Temperature (°C)	24.7	9.9	
Field pH (SU)	6.19	6.75 J	Within 1 unit of natural background
Field Dissolved Oxygen (% saturation)	119.0 J	100.4	* 70%
Field Specific Conductance (µmhos/cm)	20.0	29.1	50% above background or 1275, whichever is greater
Alkalinity (mg $CaCO_3$/L)	4.0	6.2	Shall not be depressed below 20
Color (PCU)	38	23 A	N/A
Total Phosphorus (mg/L) as P	0.21	0.14	** 0.06
Nitrate+Nitrite (mg/L) as N	0.16	0.24	0.35 for spring vents only
Ammonia (mg/L) as N	0.007	0.014	***3.93 and 9.76
Total Kjeldahl Nitrogen (mg/L) as N	0.21	0.23	N/A
Total Nitrogen (mg/L) as N	0.37	0.47	**Panhandle West: 0.67
Eschericha coli (*E. coli*) (MPN/100 mL)	N/A	547.5 Q	≤ 410 Count/100 mL

* Instantaneous DO criterion calculated per DO Saturation Calculator

** Annual geometric numeric nutrient threshold for Panhandle West nutrient region, used in combination with information on flora and fauna.

*** Total ammonia criterion calculated per https://floridadep.gov/dear/water-quality-standards-program/documents/total-ammonia-nitrogen-calculator%C2%A0, for single sample maximum.

A qualifier: Value reported is the arithmetic mean (average) of two or more determinations.

J qualifier: Value reported is estimated due to continuing calibration verification failure.

Q qualifier: Value is derived from a sample that was prepared or analyzed after the approved holding time restrictions for sample preparation or analysis.

Table 2. Floral and faunal assessment results from August 15, 2017 and January 21, 2020 at Crooked Creek.

Floral/Faunal Metric	Evidentiary Threshold of No Imbalances	Result 8/15/2017 Sample 77863	Result 1/21/2020 Sample 80654
LVS C of C	Site average ≥ 2.5	Pass (<2m^2)	Pass (<2m^2)
LVS FLEPPC (%)	Site average ≤ 25%	Pass (<2m^2)	Pass (<2m^2)
RPS (%)	≤ 25% rank 4-6 (algae > 6 mm thick) coverage. If 20 to 25 % rank 4-6 coverage, evaluate algal species	0%	0%
Chlorophyll *a* (corrected; µg/L)	< 3.2 ug/L. If 3.2 to 20 ug/L, site specific evaluation	2.7	6.8
Algal Community Composition	No adverse shifts in dominant taxa	N/A	N/A
SCI	Average ≥ 40	68	71

Habitat Assessment

The stream and river habitat assessment scores were 137 and 133, which are in the Optimal range. The typical velocity measured was 0.25 m/s, which resulted in a Suboptimal score for stream flow. Fish and aquatic insects require sufficient water velocity to maintain high dissolved oxygen concentrations in the stream; in this case the dissolved oxygen was estimated to be 119.0% in 2017 and was 100.4% saturation in 2020. While the dissolved oxygen saturation field measurements in 2017 was estimated, past observations indicate the stream meets water quality standards for DO (2014-2015, average 102.5%). The average width within the assessment stretch was 6 m. The banks were well armored and low with a gradual slope, providing a good connection with the floodplain. The bank stability scores, as a result, were in the Optimal range. Three major productive habitats were noted: woody debris, leaf packs, and roots which comprised roughly 16% (2017) and 7% (2020) of the stream area. During both sampling events, there was an adequate number of stable pools and less than 25% of habitats affected by sand, silt, or algae smothering which resulted in scores within the optimal range. Finally, no artificial channelization was evident and good quality and width of the riparian zone resulted in optimal scores for these parameters.

Faunal Assessment (SCI)

The SCI score for this site was 68 in 2017 and 71 in 2020 out of a possible 100 points, corresponding with an "Exceptional" designation (Table 2). These results are lower than previous scores for this site, which ranged from 84 to 88 (most recent version of SCI only, from 2014-2015). While scores are lower than previous scores, the site still maintains "Exceptional" designation. Future sampling events will continue to monitor the SCI community to ensure expectations of a healthy stream are met. Total taxa in 2017 and 2020 were 33 and 28, respectively. In minimally disturbed streams, we expect low values for percent very tolerant organisms, but high values for percent filter feeders. Values for percent very tolerant and percent filter feeders in the Crooked Creek sampling site were 1.3% and 46.5% in 2017, and 0.6% and 47% in 2020, respectively. Percent dominant taxon is also expected to be lower in minimally disturbed streams. At the Crooked Creek site, percent dominant taxon was 37.5% in 2017 and 34.6% in 2020. However, the dominant taxon was *Cheumatopsyche* sp., which is also included in the trichoptera (5 taxa in 2017, 4 taxa in 2020) and clinger metrics (11 taxa in 2017 and 2020). Trichoptera taxa, clinger taxa, sensitive taxa, long-lived taxa, and ephemeroptera taxa are expected in minimally disturbed streams such as

Crooked Creek. In 2017, the number of long-lived taxa was 5 and the number of sensitive taxa was 10, whereas in 2020 there were 4 long-lived and 11 sensitive taxa, respectively. Six ephemeroptera taxa were present in 2017, and 7 taxa were present in 2020.

Conclusions

Sampling at Crooked Creek indicates that the stream met applicable State Water Quality Criteria for most parameters. Total phosphorus was above the Panhandle West threshold (0.06 mg/L). Alkalinity was below 20 mg $CaCO_3$/L, but alkalinity values recorded for these sampling events are typical for this system and was likely due to natural conditions. *E. coli* exceeded water quality standards in 2020, but due to the holding time exceedance, these results are inconclusive. Chlorophyll *a* was above 3.2 ug/L in 2020, but below 20 ug/L and thus site-specific evaluation is necessary to form any conclusions. Although the thresholds were exceeded for total phosphorus, chlorophyll *a*, and *E. coli,* additional sampling may be needed to meet data sufficiency requirements to calculate and assess attainment of the water quality standard. Standards were achieved for all other water quality parameters collected for both sampling events.

Habitat Assessment data indicated a near optimal physical condition of the creek with little disturbance in the watershed. Stream Condition Index data indicated the presence of a "Healthy" macroinvertebrate community with sensitive and long-lived taxa that are indicative of good water quality conditions. The Linear Vegetation Survey and Rapid Periphyton Survey indicated vascular plant and algal communities, respectively, that are consistent with expectations for minimally disturbed sites.

Thank you for your interest in maintaining the water quality of Florida's aquatic resources. Please contact us if you have any questions.

Contact and resources for more information

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DEP biological assessment resources:
https://floridadep.gov/dear/bioassessment

Freshwater Algal Bloom information:
https://floridadep.gov/dear/algal-bloom