LAKE ECOSUMMARY

Starke Lake, 3002D, Orange County, 07/06/2017 and 05/21/2018



Figure 1. Starke Lake (WIN ID G2CE0094) in Orange County. (Aerial Imagery 2018 - FDOR, FDOT)

DEP conducted water quality and biological sampling at Starke Lake (WIN ID G2CE0094) in Orange County on 07/06/2017 and 05/21/2018 to assess attainment of designated uses. This lake was sampled as part of a strategic monitoring program. Overall, the plant community data indicated that the lake met expectations for a healthy, well-balanced lake; however, the water quality data were inconclusive.

Background

Healthy, well-balanced lake communities may be maintained with some level of human activity, but excessive human disturbance may result in lake degradation. Human stressors include increased inputs of nutrients, sediments and/or pesticides from watershed runoff, undesirable removal of native shoreline and/or upland buffer vegetation, and introduction of nuisance (generally exotic) plants and animals. DEP has methods to evaluate if human activities have resulted in a specific waterbody exceeding water quality criteria (Chapter 62-302, Florida Administrative Code [F.A.C.]), 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 support), and exceedances of these standards are associated with interference with the designated use. DEP assesses the health of plant communities in Florida lakes, as one indication of whether adverse impacts to biological communities have occurred.

Site Description

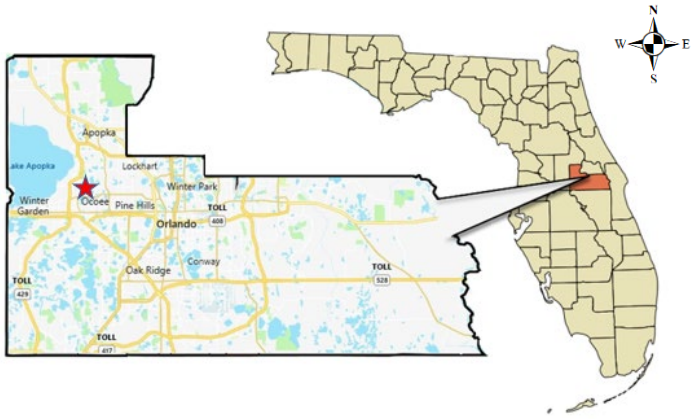


Figure 2. Location of Starke Lake in Orange County.

Starke Lake is within the City of Ocoee and part of the Wekiva River Drainage Basin. The area of the lake is approximately 208 acres with depths up to 7 meters. The predominant land uses surrounding Starke Lake are urban residential homes and public facilities. The waterbody is considered one of the FAB FIVE lakes by the Florida Fish and Wildlife Commission for fishing opportunities. The FAB FIVE are five water bodies in the FWC Fish Orlando program that are managed for fish size or a unique fishing experience. This lake is not currently listed for any parameters on the Impaired Waters Verified List (November 15, 2019). Additional

information about this WBID is available in the TMDL Tracker application (http://webapps.dep.state.fl.us/DearTmdl/tmdlReportAction.do?method=report).

Methods

Water Quality

This lake was sampled on 07/06/2017 and 05/21/2018 by the DEP Central Regional Operations Center (CEROC). Surface water samples were collected from the center of the lake for analysis of nutrients, metals, chlorophyll *a*, color, alkalinity, chloride, fluoride, total suspended solids, total dissolved solids, turbidity, sulfate and E. coli following DEP Standard Operating Procedures (SOPs; see http://dep.state.fl.us/water/sas/sop/sops.htm). Sampling and analyses met DEP quality assurance/quality control standards. Results were compared with applicable Class III water quality criteria contained in 62-302, F.A.C., including nutrients, dissolved oxygen, and other indicators.

Chlorophyll *a* is a measure of algal biomass in the water column. Chapter 62-302.531, F.A.C., provides numeric criteria for chlorophyll *a*, total nitrogen (TN), and total phosphorus (TP) in lakes, and is dependent upon the long term mean color and alkalinity of the lake (Table 1). If the annual geometric mean chlorophyll *a* (calculated with at least four samples, representing seasonal variability) does not exceed the chlorophyll *a* value for the lake type in Table 1, then the TN and TP criteria for that calendar year shall be the annual geometric means of lake TN and TP samples, subject to the minimum and maximum limits in Table 1. If there are insufficient data to calculate the annual geometric mean chlorophyll *a* for a given year or the annual geometric mean chlorophyll *a* exceeds the values in Table 1 for the lake type, then the applicable numeric interpretations for TN and TP shall be the minimum values in Table 1.

Table 1. Numeric nutrient criteria in lakes, 62-302.531 (2)(b)(1), F.A.C. AGM = annual geometric mean

Long Term Geometric Mean Lake Color and Alkalinity	AGM Chlorophyll *a*	AGM TP Range	AGM TN Range
> 40 Platinum Cobalt Units	**20 µg/L**	**0.05 to 0.16[1] mg/L**	**1.27 to 2.23 mg/L**
≤ 40 Platinum Cobalt Units and > 20 mg/L $CaCO_3$	**20 µg/L**	**0.03 to 0.09 mg/L**	**1.05 to 1.91 mg/L**
≤ 40 Platinum Cobalt Units and ≤ 20 mg/L $CaCO_3$	**6 µg/L**	**0.01 to 0.03 mg/L**	**0.51 to 0.93 mg/L**

[1] For lakes with color > 40 PCU in the West Central Region, the maximum TP limit is 0.49 mg/L

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 Peninsula region for DO criteria assessment. Percent saturation incorporates factors such as temperature, atmospheric pressure, and salinity. For lakes, the daily average DO level shall be calculated as the average of measurements collected in the upper two meters of the water column at the same location on the same day.

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 instantaneous value with a time-of-day-specific translation of the daily average criterion (62-303.420(9), F.A.C.), and a spreadsheet calculator for this purpose is available at: http://www.dep.state.fl.us/water/wqssp/swq-docs.htm.

Lake Vegetation Index

The Lake Vegetation Index (LVI) assesses how closely the plant community of a lake resembles a native undisturbed community. The LVI was sampled and

calculated per DEP SOP LVI 1000 and calculated per DEP SOP LVI 2000. Species lists were developed for four of twelve sections of the lake (Figure 3), and the following information was derived from those lists: percent native species, percent Category 1 invasive exotic species as identified by the Florida Exotic Pest Plant Council, percent sensitive species, and the coefficient of conservatism (C of C)of the dominant or co-dominant species (C of C is a measure of how tolerant a species is of disturbance). Rules 62-303.330 and 62-303.430, F.A.C., provide that a LVI score of 43 or greater meets the expectation of a healthy, well balanced community, and scores below 43 are considered impaired.

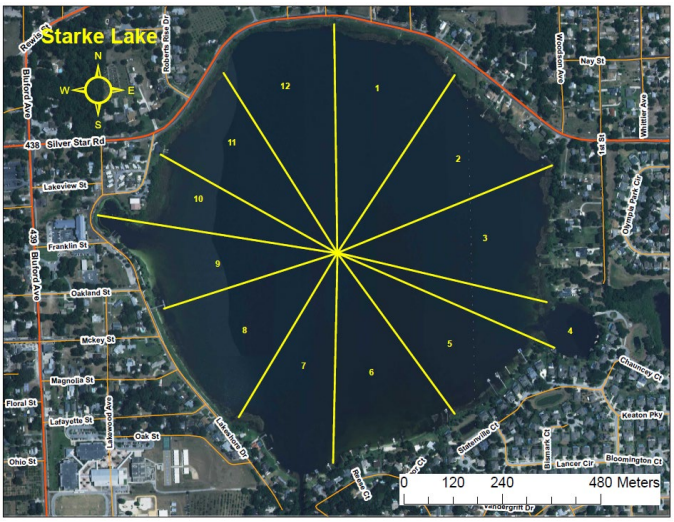


Figure 3. LVI sampling map of Starke Lake. Sections 2,5,8,11 were assessed in 2017 and sections 3,6,9,10 were assessed in 2018 for the Lake Vegetation Index. The water quality sample was collected from the lake center.

Results

Water Quality

The water quality results are shown in Table 2.

Based on these two sampling events, Starke Lake is in the low color, high alkalinity lake category. For these two sampling events, the lake exceeded the chlorophyll *a* threshold and therefore must be assessed with the low-end TN and TP thresholds. The TP threshold was met but the TN threshold was exceeded for both samples; 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. DEP's Watershed Assessment Section will evaluate the complete dataset for this lake to assess compliance with nutrient criteria.

Table 2. Water quality results from 07/06/2017 and 05/21/2018 at Starke Lake.

Analyte	**Result** 07/06/2017	**Result** 05/21/2018	**Applicable Class III Water Quality Criteria**
Field Temperature (°C)	31.6	25.47	N/A
Field pH (SU)	8.5	7.87	Within 1 SU of natural background
Field Dissolved Oxygen (% saturation)	8.8 (119%)	7.7 (93.4%)	*Peninsula Criteria: >7.35 mg/L, >8.19 mg/L (>36.27%, >34.51%)
Field Specific Conductance (µmhos/cm)	272	253	50% above background or 1275 µmhos/cm, whichever is greater
Alkalinity (mg $CaCO_3$/L)	55 A	56	Shall not be depressed below 20
Color (PCU)	17	17	N/A
Chlorophyll *a* (µg/L)	22 A	35 A	≤ 20 µg/L for colored and alkaline clear lakes
Total Phosphorus (mg/L) as P	0.020	0.027	0.03 mg/L
Nitrate+Nitrite (mg/L) as N	0.004 U	0.004 U	N/A
Ammonia (mg/L) as N	0.005	0.006	**<0.41 mg/L, <1.63mg/L
Total Kjeldahl Nitrogen (TKN) (mg/L) as N	1.4	1.6	N/A
Total Nitrogen (mg/L) as N	1.40	1.60	1.05 mg/L

* Instantaneous DO criterion calculated per DO Saturation Calculator.

** Total ammonia criterion calculated per Total Ammonia Nitrogen Calculator

A - Value reported is the mean of two or more determinations.

U – Material was analyzed for but not detected. The reported value is the method detection limit for the sample analyzed.
NA - Not applicable

Lake Vegetation Index

The 2017 LVI score for this lake was 48 out of a possible 100 points, corresponding with a "Healthy" designation. Table 3 contains the species list and occurrence information for this sampling event. A total of 10 invasive exotic plant species were observed in the lake. These are denoted with asterisks in the table. Illinois pondweed (*Potamogeton illinoensis*) was the dominant species in three sections. In the fourth section it was codominant with Torpedo Grass (*Panicum repens*). Additionally, invasive exotic species consisting of Cogon grass (*Imperata cylindrica*) and Camphor tree (*Cinnamomum camphora*) were also observed along shoreline buffer areas.

The 2018 LVI score for this lake was 45 out of a possible 100 points, corresponding with a "Healthy" designation. Table 4 contains the species list and occurrence information for this sampling event. A total of 7 invasive exotic plant species were observed in the lake. No dominant species were observed in two out of four assessed sections (section 6 and 9). Torpedo Grass (*Panicum repens*) and Southern Umbrella Sedge (*Fuirena scirpoidea*) were observed as co-dominants in section 3. Maidencane (*Panicum hemitomon*) and Southern Umbrella Sedge (*Fuirena scirpoidea*) were observed as codominants in section 10.

Table 3. Species list for the 07/06/2017 LVI at Starke Lake. An asterisk (*) indicates an invasive exotic plant species. P = present, D = dominant, C = codominant.

Lake Starke, 07/06/2017		**Sections**			
Taxon Name	**Common Name**	**1**	**2**	**3**	**4**
Acer rubrum	Red Maple	P	P	P	P
*Alternanthera philoxeroides**	Alligator Weed				P
Baccharis	Salt Bush	P	P	P	
Bacopa monnieri	Herb of Grace			P	
Ceratophyllum demersum	Coontail				P
Chara	Musk Grass	P			P
*Colocasia esculenta**	Taro	P		P	P
Commelina	Dayflower			P	
Cyperus odoratus	Fragrant Flatsedge		P		
Cyperus polystachyos	Manyspiked Flatsedge			P	
Echinochloa walteri	Coast Cockspur		P	P	
*Eichhornia crassipes**	Water Hyacinth		P	P	P
Eleocharis interstincta	Knotted Spikerush	P	P	P	P
Eleocharis submersed viviparous (species unknown)	Viviparous Spikerush			P	P
Erechtites hieraciifolius	Fireweed				P
Eupatorium capillifolium	Dogfennel			P	P
Fuirena scirpoidea	Southern Umbrella Sedge	P	P	P	P
*Hydrilla verticillata**	Hydrilla				P
Hydrocotyle	Marsh Pennywort	P		P	P
Juncus effuses	Soft Rush				P
Juncus repens	Lesser Creeping Rush	P			
Ludwigia (native)	Primrosewillow	P	P		P
*Ludwigia peruviana**	Peruvian Primrosewillow	P	P	P	P
Ludwigia repens	Creeping Primrosewillow				P
Mikania scandens	Climbing Hempviene				P
Myrica cerifera	Wax Myrtle	P		P	P
Nitella	Green Algae			P	
Nuphar	Spatterdock	P	P		P
Nymphaea odorata	American White Lily	P	P	P	P
Panicum hemitomon	Maidencane	P		P	P
*Panicum repens**	Torpedo Grass	C	P	P	P
Paspalum urvillei	Vasey Grass				P
Pluchea	Camphor Weed			P	P
Polygonum punctatum	Dotted Smartweed				P
Pontederia cordata	Pickerelweed	P	P	P	P
Potamogeton illinoensis	Illinois Pondweed	C	D	D	D
Sagittaria lancifolia	Bulltongue Arrowhead	P	P	P	P
Salix caroliniana	Carolina Willow	P	P	P	P
*Salvinia minima**	Water Spangles				P

Sambucus canadensis	Elderberry	P	P		P
*Sapium sebiferum**	Chinese Tallow Tree			P	P
*Schinus terebinthifolius**	Brazilian Pepper	P	P		
Taxodium	Cypress	P	P	P	
Typha	Cattail	P	P		P
Utricularia inflata	Floating Bladderwort			P	
Vallisneria americana	Tape Grass	P	P		P
Vigna luteola	Hairypod cowpea		P	P	
Vitis	Grape Vine	P	P		
*Wedelia trilobata**	Creeping Oxeye			P	
Woodwardia virginica	Virgina Chain Fern				P

Table 4. Species list for the 05/21/2018 LVI at Starke Lake. An asterisk (*) indicates an invasive exotic plant species. P = present, D = dominant, C = codominant.

Lake Starke, 05/21/2018		**Sections**			
Taxon Name	**Common Name**	**1**	**2**	**3**	**4**
Acer rubrum	Red Maple				P
*Alternanthera philoxeroides**	Alligator Weed	P	P		
Azolla caroliniana	Mosquito Fern	P	P		
Bidens alba	Beggar Ticks				P
Ceratophyllum demersum	Coontail			P	
Chara	Musk Grass		P	P	
*Colocasia esculenta**	Taro		P		P
Cyperus odoratus	Fragrant Flatsedge				P
*Eichhornia crassipes**	Water Hyacinth		P	P	
Eleocharis interstincta	Knotted Spikerush	P	P	P	
Eleocharis submersed viviparous (species unknown)	Viviparous Spikerush	P		P	
Fuirena scirpoidea	Southern Umbrella Sedge	C	P	P	C
Hydrocotyle	Marsh Pennywort			P	P
Juncus effuses	Soft Rush				P
Juncus elliottii	Bog Rush		P		
Lemna	Duckweed	P	P		
Ludwigia leptocarpa	Anglestem Primrose Willow		P	P	
Ludwigia octovalvis	Mexican Primrose Willow		P		
*Ludwigia peruviana**	Peruvian Primrose Willow		P		
Mikania scandens	Climbing Hempvine		P		
Nymphaea odorata	American White Lily	P	P	P	P
Panicum hemitomon	Maidencane			P	C
*Panicum repens**	Torpedo Grass	C	P	P	
Pluchea	Camphor Weed		P		P
Polygonum punctatum	Dotted Smartweed	P	P	P	
Pontederia cordata	Pickerelweed	P	P	P	P
Potamogeton illinoensis	Illinois Pondweed	P	P	P	P
Ptilimnium capillaceum	Mock Bishop Weed		P		
Rumex	Dock			P	
Sagittaria lancifolia	Bulltongue Arrowhead	P	P	P	P
Salix caroliniana	Carolina Willow	P			P
Salvinia minima	Water Spangles	P	P		
*Schinus terebinthifolius**	Brazilian Pepper	P			
Schoenoplectus californicus	Giant Bulrush				P
Schoenoplectus tabernaemontani	Softstem Bulrush		P		P
Taxodium	Cypress	P	P	P	
Typha	Cattail	P	P		
*Urochloa mutica**	Paragrass	P			
Utricularia gibba	Humped Bladderwort	P	P		
Vallisneria americana	Tape Grass			P	P

Conclusions

Sampling at G2CE0094 indicates that the lake did not meet applicable State Water Quality Criteria for chlorophyll *a* or total nitrogen. Total nitrogen (a measure of TKN plus nitrate/nitrite) measured in Starke Lake on 07/06/2017 and 05/21/2018 was almost entirely comprised of TKN, a measure of the organic and ammonia/ammonium forms of nitrogen. The labile, organic fraction accounted for nearly all the TKN, meaning that the more biologically available forms of nitrogen that can lead to eutrophication were minimal.

However, high percent dissolved oxygen saturation (>100% on 7/6/17) indicates active phytoplankton production during the sampling event. The nitrogen, chlorophyll *a*, and DO results indicate further data are needed to establish a clear picture of the water quality at Starke Lake. The Lake Vegetation Index results indicated plant communities that are consistent with the low end of expectations for a healthy, well-balanced lake. Additional nutrient and chlorophyll data from throughout the assessment period will be required to fully determine an impairment listing status for this waterbody. As Starke Lake is at the low end of the "healthy" range for the LVI, and the nutrient results are close to thresholds, DEP will continue to monitor and assess this waterbody to ensure compliance with Florida water quality standards.

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

Contact and resources for more information

Terry Riordan
407-897-2959
Terry.Riordan@FloridaDEP.gov

DEP publications on Best Management Practices and Environmental Stewardship and Education:
http://www.dep.state.fl.us/water/nonpoint/pubs.htm
DEP biological assessment resources:
http://www.dep.state.fl.us/water/bioassess/index.htm
FWCC Aquatic Plant Management:
http://myfwc.com/wildlifehabitats/invasive-plants/
Freshwater Algal Bloom information:
http://www.dep.state.fl.us/water/bgalgae/index.htm