

East Lake

Methods

Study Area Analysis

The watershed containing East Lake was analyzed using ESRI ArcGIS 10.2. Using this software with 2014 Hillsborough County aerial, Land Use/ Land Cover (LULC), Landscape Development Intensity (LDI) Index values were calculated for the 100 meter buffer surrounding the lake following the procedures of Brown & Vivas 2003, 2005 (Brown & Vivas. 2003. A Landscape Development Intensity (LDI) Index. Center for Environmental Policy, Department of Environmental Engineering Sciences, University of Florida. Technical Report Submitted to the Florida Department of Environmental Protection) and (Brown & Vivas. 2005. Landscape development intensity index. Environmental Monitoring and Assessment 101: 289-309.) According to Brown and Vivas, “The intensity and aerial extent of human activities in a landscape may adversely affect the ecological processes of natural communities...the Landscape Development Intensity Index (LDI) functions as an objective measure of how human disturbance affects biological, chemical, and physical processes of aquatic systems. By incorporating non-renewable energy input expenditures... natural systems were assigned a non-renewable empowerment density of 1. The landscape development intensity (LDI) index is calculated as the percentage area within the catchment of a particular type of land use multiplied by the coefficient of energy use associated with that land use, summed over all land use types found in the catchment.”

Lake Bathymetry and Morphological Characteristics Assessment

The **Bathymetric Map**ⁱ provides the lake’s morphologic parameters in various units. The bottom of the lake was mapped using a Lowrance HDS 5 Gen 2 Wide Area Augmentation System (WAAS)ⁱⁱ enabled Global Positioning System (GPS) with fathometer (bottom sounder) to determine the boat’s position, and bottom depth in a single measurement. The result is an estimate of the lake’s area, mean and maximum depths, and volume and the creation of a bottom contour map. Besides pointing out the deeper fishing holes in the lake, the morphologic data derived from this part of the assessment can be valuable to overall management of the lake vegetation as well as providing flood storage data for flood models.

ⁱ A bathymetric map is a map that accurately depicts all of the various depths of a water body. An accurate bathymetric map is important for effective herbicide application and can be an important tool when deciding which form of management is most appropriate for a water body. Lake volumes, hydraulic retention time and carrying capacity are important parts of lake management that require the use of a bathymetric map.

ⁱⁱ WAAS is a form of differential GPS (DGPS) where data from 25 ground reference stations located in the United States receive GPS signals from GPS satellites in view and retransmit these data to a master control site and then to geostationary satellites. For more information, see end note 2.

Lake Vegetation Index Assessment

Hillsborough County requested the implementation of the Florida Department of Environmental Protection methods for Lake Vegetation Index (LVI 1000)

(<http://www.dep.state.fl.us/water/sas/sop/sops.htm>) using forms FD 9000-03 (Physical/Chemical Characterization), FD 9000-06 (Lake Habitat Assessment) FD 9000-27 (LVI Field Sheet) and FD 9000-31 (Lake Observation Field Sheet).

The Lake Vegetation Index (LVI) is a rapid assessment protocol in which selected sections of a lake are assessed for the presence or absence of vegetation through visual observation and through the use of a submerged vegetation sampling tool called a Frodus. The assessment results provide a list of species presents and the dominant and where appropriate co-dominant species that are found in each segment. These results are then entered into a scoring table and a final LVI score is determined. LVI scores provide an estimate of the vegetative health of a lake. Our assessment team was trained and qualified by FDEP to conduct these assessment as an independent team and must prequalify each year prior to conducting additional assessments. The LVI method consists of dividing the lake into twelve pie-shaped segments (see diagram below) and selecting a set of four segments from the twelve to include in the LVI. The assessment team then travels across the segment and identifies all unique species of aquatic plant present in the segment. Additionally, a Frodus is thrown at several points on a single five-meter belt transect that is established in the center of the segment from a point along the shore to a point beyond the submerged vegetation zone. For scoring, the threshold score for impairment is 37.

Four metrics are utilized in the Lake Vegetation Index Survey; Dominant Coefficient of Conservatism (CoC), Percent Florida Exotic Pest Plant Council Type 1 (% FLEPPC), Percent Native Taxa, Percent Sensitive Taxa.

The Dominant Coefficient of Conservatism (CoC) metric for the dominant or co-dominate species in each section. The CoC applies a score of 0-10 to each species based on its ecological tolerances and fidelity to pre-settlement conditions. Species with higher scores show a high fidelity to native, undisturbed habitats and are typically sensitive to alterations. Available CoC scores can be obtained from LT 7000 from the Florida Department of Environmental Protection at: <http://www.dep.state.fl.us/water/sas/sop/sops.htm>.

The percent FLEPPC (Florida Exotic Pest Plant Council) Category 1 invasive exotic taxa in a single sampling unit (pie slice) by dividing the number of FLEPPC Category I taxa by the total number of taxa in that sampling unit. Multiply result times 100. Refer to Appendix LVI 1000-1 to determine which plants are on the FLEPPC Category 1 list. Note that not all exotic taxa should be included in this metric, only those listed in Appendix LVI 1000-1 as Category 1 FLEPPC. If the FLEPPC updates their list of Category 1 exotics, those updates shall not be reflected in this calculation until they are included in Appendix LVI 1000-1.

The percent native taxa in a single sampling unit (pie slice) is calculated by dividing the number of native taxa by the total number of taxa in that sampling unit. Multiply result times 100. Nativity status is determined by the Plant Atlas from the Institute for Systematic Botany, and is listed in

Appendix LVI 1000-1. For informational purposes, visit the website <http://www.florida.plantatlas.usf.edu/>. Taxa that are native according to the Plant Atlas from the Institute for Systematic Botany but are not on the list in Appendix LVI 1000-1 may be included in this metric calculation, but inclusion of these additional taxa is not required.

The percent sensitive taxa in a single sampling unit by summing the number of taxa with a C of C (Coefficient of Conservatism) score ≥ 7 and then dividing by the total number of taxa in that sampling unit. Multiply result times 100. Refer to Appendix LVI 1000-1 for a list of C of C scores.

The collected bathymetric data is analyzed for submerged aquatic vegetation (SAV) calculations including the percentage of the surface area of the lake inhabited by SAV as well as an estimate of the percent volume of the lake inhabited by SAV. SAV is an important component to a lakes nutrient cycling as well as chlorophyll concentrations due to the SAV and phytoplankton competing for available nutrients in the water column. In addition SAV serves a vital role as habitat for many species of macroinvertebrates and fish as well as substrate for epiphytic algae.

Water Quality Assessment

Physical water quality samples were taken using a Eureka Manta Sub-2 multiprobe pre and post calibrated on the day of the assessment. Measurements taken with this device include: depth, conductivity, pH, Dissolved Oxygen (mg/l and % Saturation) and salinity. Chemical water parameters were collected and preserved on ice by USF Water Institute staff and analyzed at the Environmental Protection Commission of Hillsborough County Laboratory. Analysis include; Chlorophyll (a, b, c, t and corrected), Alkalinity, Color, Fecal Coliform, Enterococci, Ammonia, Nitrates/Nitrites, Total Phosphorous, Kjeldahl Nitrogen and Total Nitrogen. The results of the water quality sampling effort will be discussed in the framework of the FDEP Numeric Nutrient Criteria

Study Area

East Lake is located between East Hillsborough Avenue and I-4 in East Lake-Orient Park, Florida. The Landscape Development Intensity Index of the 100 meter buffer around East Lake is dominated by Residential (57.55%) and Institutional (17.91%) land uses. The resulting LDI value for the 100 meter buffer around East Lake is 7.73.



Figure 1 2016 East Lake Assessment Study Area Map

Lake Bathymetry and Morphological Characterization

East Lake is a shallow eutrophic lake with a surface area of 104.44 acres. East Lake at the time of the assessment had a mean water depth of 5.4 feet and a maximum observed depth of 8.4 feet. The volume at this time was approximately 183,852,887 gallons. Figure 2 shows the resulting bathymetric contour map for East Lake from data collected on July 21, 2016. The collected data has been overlain the 2014 Hillsborough County aerials.



Figure 2 2016 1-Foot Bathymetric Contour Map for East Lake

Table 1 Morphological Calculations for East Lake

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	4,549,259	422,636	104.44	0	0
Mean Depth	5.40	1.65	0	0	0
Maximum Depth	8.4	2.56	0	0	0
Volume (cubic)	24,577,386	695,947	0	564.2	183,852,887
Gauge (relative)	22.78	6.95	0	0	0

Lake Vegetation Index Assessment



Figure 3 Overview photograph of East Lake

The lake assessment for East Lake was conducted on July, 2016. East Lake received a lake habitat assessment (FEDP form FD 9000-6) score of 60 due to suboptimal scores for Lakeside Adverse Human Alterations and marginal scores for Vegetation Quality, Stormwater Inputs, Bottom Substrate Quality, Upland Buffer Zone and Adverse Watershed Land Use. Poor scores were recorded for Secchi Depth.



Figure 4 East Lake had a buffering zone of emergent vegetation surrounding about half of the shoreline, the remainder was mostly seawall with some areas of native vegetation shown above.

The Lake Vegetation Index identified 33 species of wetland vegetation growing in the four selected sections along East Lake. The majority of these species (22) are native species. The remaining 11 species (shown in bold on Table 2) are non-native and invasive to this region. The vegetation community along East Lake is dominated by a variety of emergent species including *Pontederia cordata* (Figure 4) and *Typha* (Figure 5). The water's surface in East Lake was dominated by *Nuphar* (Figure 6). The calculated LVI score for East Lake was 23, below the impairment threshold of 37. Figure 7 shows the map of East Lake detailing the LVI regions used for the assessment. Table 2 details the species list results of the Lake Vegetation Index. In this table, a "C" denotes that the species was identified as being Codominant in the region and a "D" denotes that the species was dominant in the region. Table 3 details the scoring result for the Lake Vegetation Index. Submerged vegetation was not observed visually or by collection on the frodus device during the assessment. By analyzing the collected sonar chart, submerged aquatic vegetation covered approximately 3% of the surface area of East Lake. This submerged vegetation inhabits an estimated 0.42% of the water volume in East Lake.



Figure 5 *Typha* was a dominant species in 3 of the 4 LVI regions on East Lake



Figure 6 *Nuphar* was the dominant species of floating leaved vegetation on East Lake

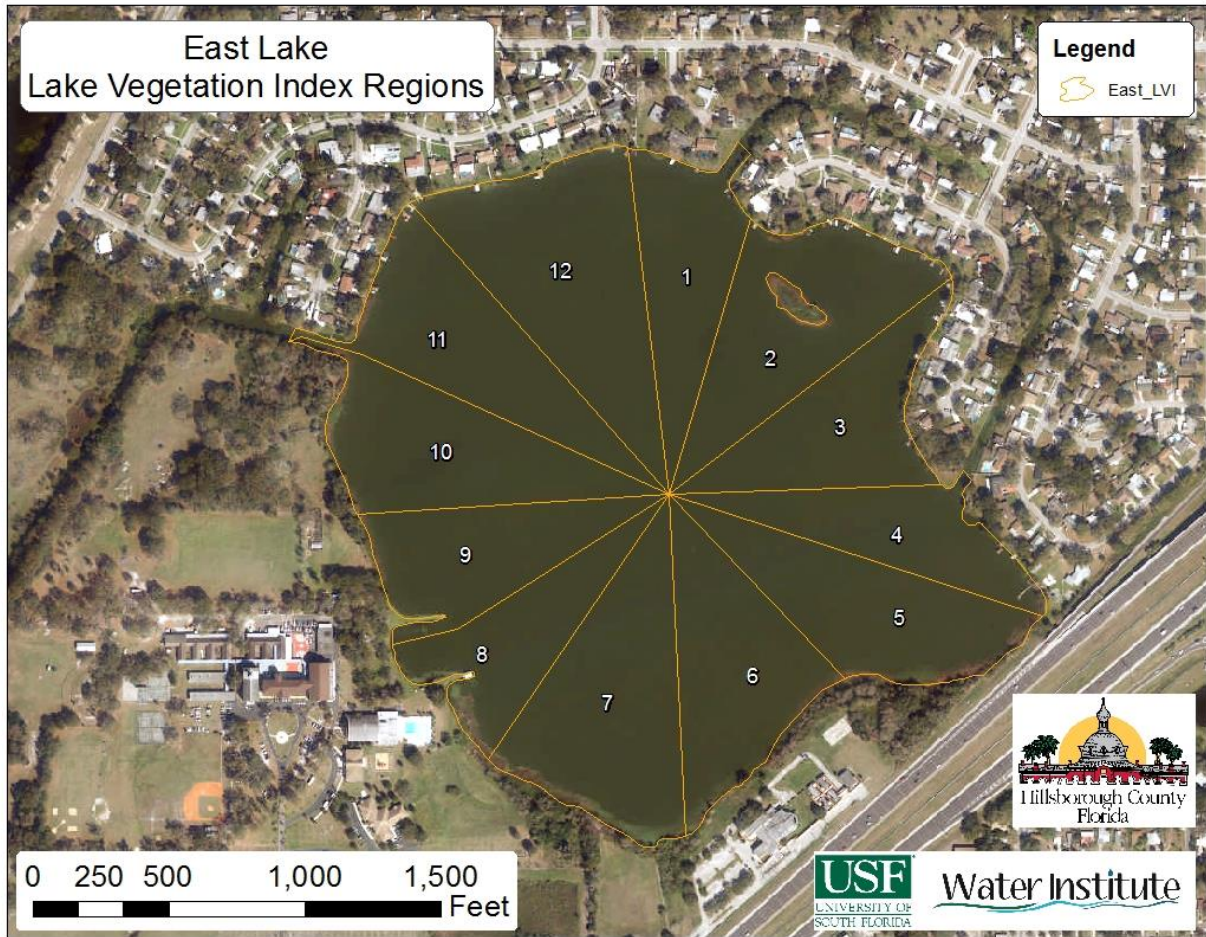


Figure 7 Lake Vegetation Index region map for East Lake

Table 2 Lake Vegetation Index results for East Lake 7/21/2016

SPECIES	Region				
	CofC	1	4	7	10
Acer rubrum	4.65	1	1	1	1
Alternanthera philoxeroides	0.00	1	1	1	1
Colocasia esculenta	0.00	1	1	1	1
Ludwigia peruviana	0.00	1	1	1	1
Mikania scandens	1.95	1	1	1	1
Nuphar	3.50	1	1	C	C
Pontederia cordata	5.38	D	C	1	1
Sagittaria latifolia	3.50	1	1	1	1
Salix caroliniana	2.95	1	1	1	1
Typha	1.00	1	C	C	C
Blechnum serrulatum	5.50		1	1	1
Boehmeria cylindrica	5.00	1	1		1
Myrica cerifera	2.00	1		1	1
Panicum repens	0.00	1	1	1	
Polygonum hydropiperoides	2.50	1	1	1	
Quercus laurifolia	4.00	1	1		1
Sphagneticola trilobata	0.00	1	1		1
Cyperus alternifolius	0.00	1	1		
Dioscorea bulbifera	0.00	1	1		
Eichhornia crassipes	0.00	1		1	
Hydrocotyle	2.00	1	1		
Ludwigia leptocarpa	3.00	1			1
Sapium sebiferum	0.00			1	1
Schinus terebinthifolius	0.00	1		1	
Taxodium	7.00	1			1
Baccharis				1	
Dryopteris ludoviciana	7.00				1
Eclipta prostrata	2.00		1		
Hymenachne amplexicaulis	0.00		1		
Persea palustris	7.00				1
Schoenoplectus californicus	5.00		1		
Schoenoplectus tabernaemontani	5.55		1		
Vitis rotundifolia	1.18				1

Table 3 Scoring Summary for the Lake Vegetation Index

LVI Score Summary	Region			
	1	4	7	10
Total # of taxa in sampling unit	23	23	18	21
% Native taxa in sampling unit	60.86957	65.21739	61.11111	76.19048
% FLEPPC CAT 1 taxa in sampling unit	26.08696	21.73913	33.33333	14.28571
% Sensitive taxa in sample unit	4.347826	0	0	14.28571
Dominant CoC in sample unit	2.69	3.19	2.25	2.25
Native Score $((x-62.5)/37.5)$ or $((x-66.67)/25.89)=$	0	0	0	0.367728
Invasive FLEPPC 1 Score $(1 - (x/30))=$	0.130435	0.275362	0	0.52381
Sensitive Score $(x/(27.78 \text{ or } 20)) =$	0.217391	0	0	0.714286
Dominant CoC Score $(x/(7.91 \text{ or } 7)) =$	0.384286	0.455714	0.321429	0.321429
Raw Score Total = $N+I+S+D =$	0.732112	0.731077	0.321429	1.927252
Division Factor = $(3 \text{ D}=0 \text{ or } 4) =$	4	4	4	4
Average LVI dividend = Raw / DF	0.183028	0.182769	0.080357	0.481813
South				
LVI Score for sampling unit =	18.3028	18.27692	8.035714	48.18129

Total LVI Score

23

Water Quality Assessment

Long-term water quality data is not available for East Lake. The available data was collected as part of this lake assessment. Table 4 provides a summary of the Physical/Chemical conditions recorded at the middle of East Lake.

Table 4 East Lake Water Quality (Field)

Depth (m)	Temp (C)	pH	DO (mg/L)	DO (% Sat)	Cond (umho/cm)	Salinity (ppt)	TDS (mg/L)
0.11	32.36	9.61	10.21	137.9	135.3	0.06	86.6
0.3	32.47	9.56	10.52	142.2	135.4	0.06	86.7
1.07	32.09	9.53	10.5	141.1	135.6	0.06	86.7
1.82	30.91	8.87	8.34	109.9	135	0.06	86.4
2.16	30.8	6.64	0.22	2.9	173.5	0.08	111

The chemical water quality analysis for East Lake is shown in Table 5 for the sample taken on July 21, 2016. Table 6 includes this data in the numeric nutrient criteria framework using the data from this assessment since geometric mean values for the past three years for available parameters are not available. Total Phosphorous values were above the nutrient threshold for clear alkaline lakes with insufficient data developed by FDEP of 0.03 mg/l with a value of 0.061 mg/l. Total Nitrogen values were above the nutrient threshold for clear alkaline lakes with insufficient data developed by FDEP of 1.05 mg/l with a value of 1.714 mg/l. Chlorophyll-a values are above the nutrient threshold for clear alkaline lakes developed by FDEP of 20.0 µg/l with a value of 40.6 µg/l. It is important to consider the NNC criteria in the context of having sufficient or insufficient data to calculate geomean values for the previous 3 years. With sufficient data, the thresholds for Total Phosphorous and Total Nitrogen raise to 0.09 mg/L and 1.91mg/L respectively.

Bacteria testing showed moderate levels of Fecal Coliform (132 colonies/100ml) below the rules set forth in FDEP 62-302.530 (<https://www.flrules.org/gateway/RuleNo.asp?title=SURFACE%20WATER%20QUALITY%20STANDARDS&ID=62-302.500>) "Most Probable Number (MPN) or Membrane Filter (MF) counts shall not exceed a monthly average of 200, nor exceed 400 in 10% of the samples, nor exceed 800 on any one day. Monthly averages shall be expressed as geometric means based on a minimum of 10 samples taken over a 30 day period."

Bacterial sampling also showed elevated colonies of Enterococci bacteria with a value of 980 colonies/100ml.

Table 5 East Lake Water Quality Results from 7/21/2016(Laboratory)

Parameter	Value	Units
Alkalinity	48.0	mg/LCaCO3
Nitrates/Nitrites	0.003	mg/L
Fecal Coliform	132	#/100 ml
Enterococci	980	#/100 ml
Chlorophyll a	45.0	ug/L
Chlorophyll b	2.6	ug/L
Chlorophyll c	5.4	ug/L
Chlorophyll t	52.7	ug/L
Chlorophylla Corr	40.6	ug/L
Chlorophyll-pheo	6.6	ug/L
Ammonia	0.012	mg/L
Kjeldahl Nitrogen	1.711	mg/L
Total Nitrogen	1.714	mg/L
Total Phosphorus	0.061	mg/L
Color(345)F.45	20.1	Pt/Co

Table 6 Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	20.1
Number of Samples	1
Geometric Mean Alkalinity (mg/L CaCO ₃)	48.0
Number of Samples	1
Lake Type	Clear Alkaline
Chlorophyll a Criteria (ug/L)	20
Insufficient for Geomean Criteria then P mg/L	0.03
Insufficient for Geomean Criteria then N mg/L	1.05
Geomean Chla ug/L	40.6
Geomean TP mg/L	0.061
Geomean TN mg/L	1.714
Number of Samples	1
Potential Impaired Chlorophyll a	Impaired
Potential Impaired TP	Impaired
Potential Impaired TN	Impaired

Conclusion

The results of the assessment of East Lake shows impairment based on Total Nitrogen, Total Phosphorous and Chlorophyll concentrations according to the FDEP numeric nutrient criteria using the single sample taken during this assessment. Long term sampling would be necessary to determine actual NNC values. The system also shows impairment in the vegetation communities according to the Lake Vegetation Index with moderate overall species, high occurrences of non-native, invasive species and a few sensitive plant species with an overall LVI score of 23. Bacteria sampling also revealed elevated biomass of Enterococci bacteria present at the time of the assessment.