

Lake Eckles

Methods

Study Area Analysis

The watershed containing Lake Eckles 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 0. 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

Lake Eckles is located south of Eckles Dr. and in between Rome Avenue and North Blvd in Hillsborough County, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Lake Eckles is dominated by Low and Medium Density Residential (90.31%) Open Land Urban (3.07%) and Golf Courses (4.20%) land uses. The resulting LDI value for the 100 meter buffer around Lake Eckles is 7.58. The LDI value calculated for the FDEP WBID containing Lake Eckles was 7.52 with approximately 62% residential and 16% Commercial and Service landscapes.

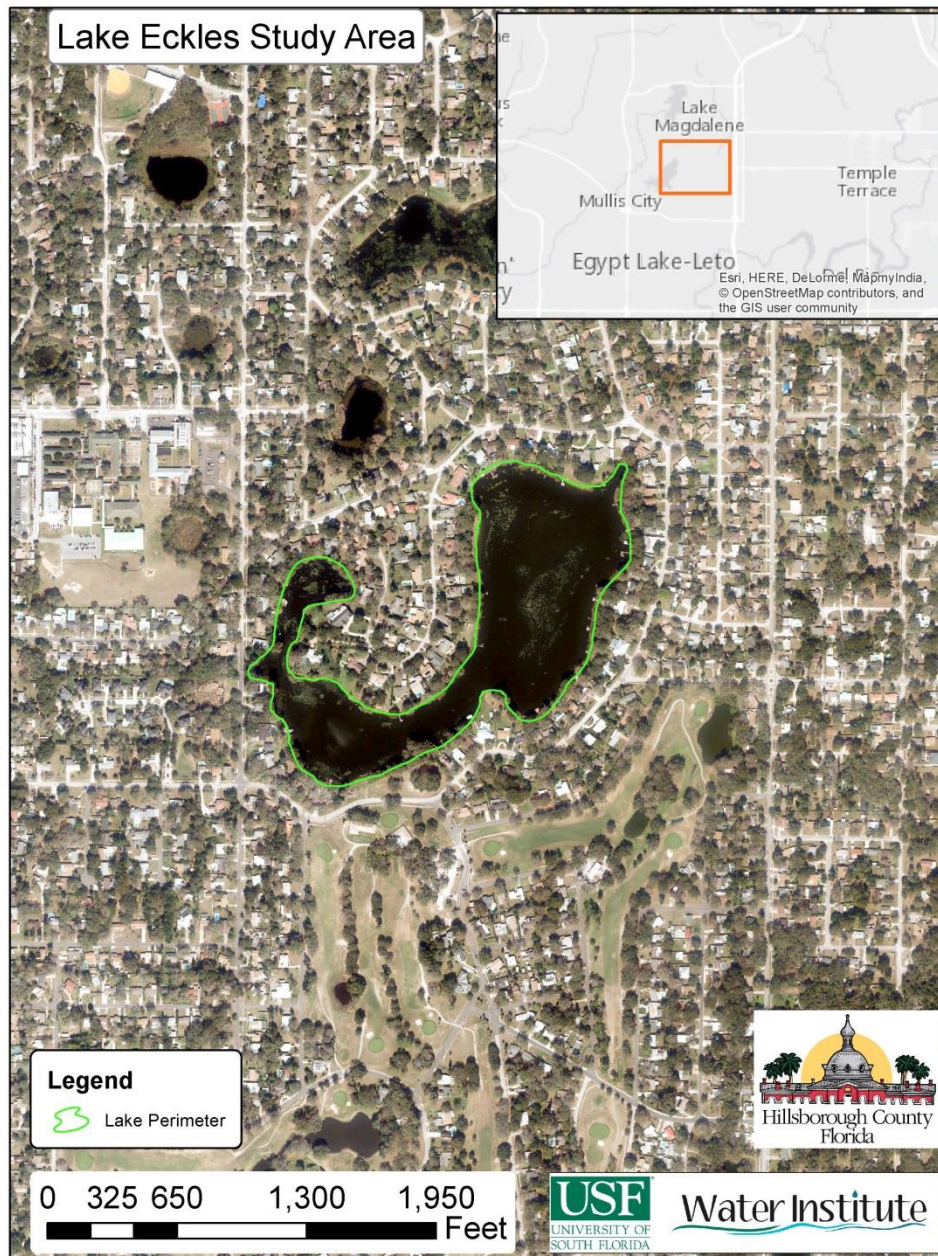


Figure 1 2016 Lake Eckles Assessment Study Area Map

Lake Bathymetry and Morphological Characterization

Lake Eckles is a crescent shaped, isolated system covering 28.5 acres. Lake Eckles at the time of the assessment had a mean water depth of 4.7 feet and a maximum observed depth of 20.1 feet. The volume at this time was approximately 43,197,223 gallons. Figure 2 shows the resulting bathymetric contour map for Lake Eckles from data collected on July 17, 2016. The collected data has been overlain the 2014 Hillsborough County aerials.

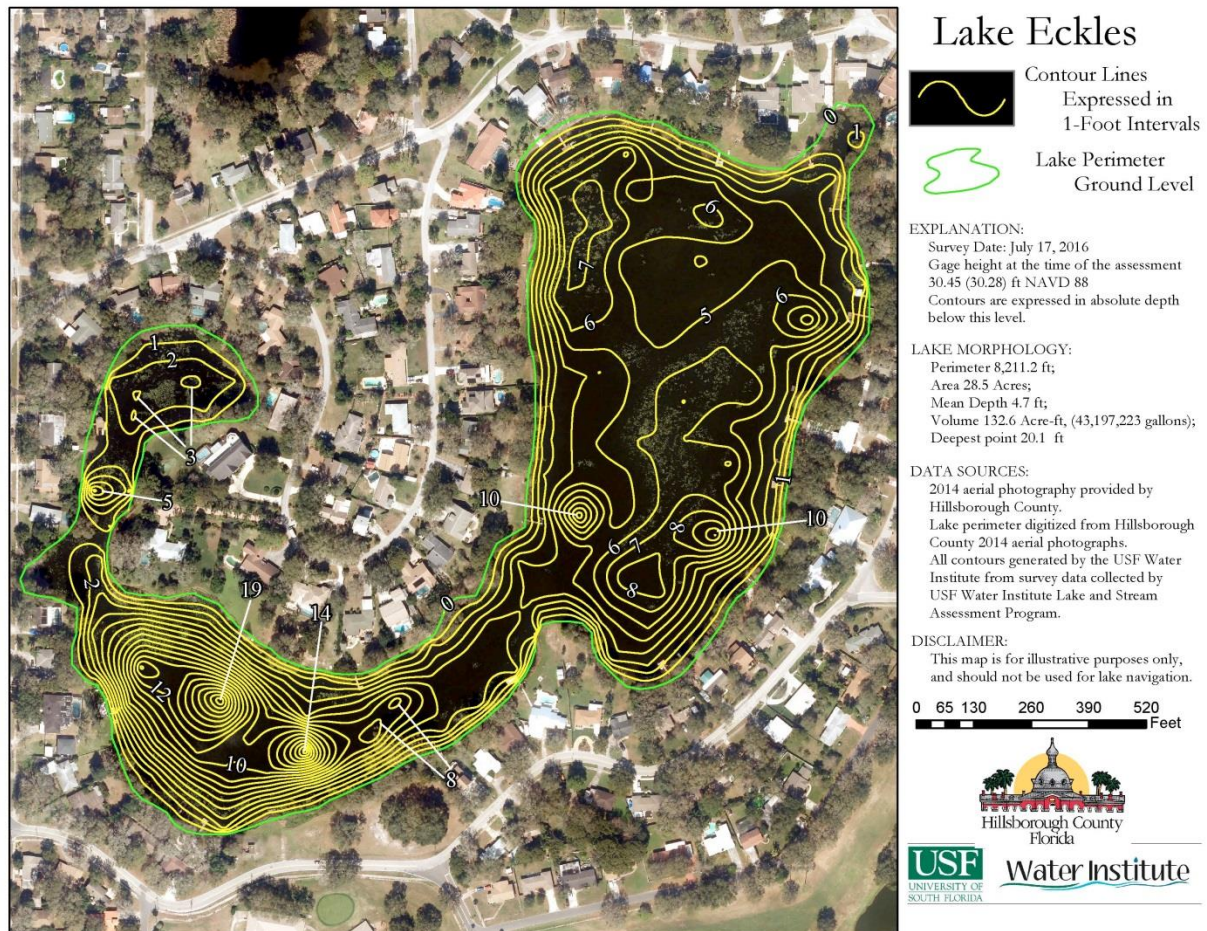


Figure 2 2016 1-Foot Bathymetric Contour Map for Lake Eckles.

Table 1 Morphological Calculations for Lake Eckles

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	1,240,158	115,213	28.5	0	0
Mean Depth	4.7	1.42	0	0	0
Maximum Depth	20.1	6.12	0	0	0
Volume (cubic)	5,774,589	163,517	0	132.6	43,197,223
Gauge (relative)	30.45	9.28	0	0	0

Lake Vegetation Index Assessment



Figure 3 Overview photograph of Lake Eckles.

The lake assessment for Lake Eckles was conducted on July 17, 2016. At the time of the assessment, Lake Eckles was in the process of conducting a whole lake treatment for the invasive submerged aquatic vegetation *Hydrilla verticillata*. This treatment has broader ranging effects on aquatic vegetation than just the targeted species. As such, the results of the Lake Vegetation Index and Submerged Aquatic Vegetation Analysis should be utilized as a snapshot of the intermediate stages of the treatment process, and not to be used as a measure of lake health per FDEP guidelines. In this report we will discuss the results in terms of the FDEP processes. Lake Eckles received a lake habitat assessment (FDEP form FD 9000-6) score of 66 with optimal scores for Secchi and marginal scores for Vegetation Quality, Stormwater inputs, Bottom Substrate Quality and Adverse Watershed Land Use. Poor scores were recorded for Upland Buffer Zone and Lakeside Adverse Human Alterations.



Figure 4 Lake Eckles had a buffering zone of emergent vegetation surrounding the lake containing a mixture of native and invasive species.

The Lake Vegetation Index identified 48 species of wetland vegetation growing in the four selected sections along Lake Eckles. The majority of these species (37) are native species. The remaining 11 species (*Hydrilla verticillata*, *Ludwigia peruviana*, *Melaleuca quinquenervia*, *Oxycaryum cubense*, *Panicum repens*, *Shinus terebinthifolius*, *Sphagneticola trilobata*, *Casuarina equisetifolia*, *Colocasia esculenta*, *Cyperus alternifolius*) are non-native and invasive to this region. The vegetation community of Lake Eckles is Co-dominated by submerged and emergent vegetation species including *Hydrilla verticillata* and *Melaleuca quinquenervia* (Figure 5). The emergent vegetation zone was dominated by *Melaleuca quinquenervia* and *Panicum repens*. The water's surface in Lake Eckles was dominated by *Nuphar* (Figure 6). The calculated LVI score for Lake Eckles was 33, below the impairment threshold of 37. Figure 7 shows the map of Lake Eckles detailing the LVI regions used for the assessment. Table 2 details the species list results of the Lake Vegetation Index. In Table 2, plant species in bold indicate non-native, invasive species. The CofC column is a measure of each individual plant Coefficient of Conservatism, a measure of each species fidelity to a natural undisturbed Florida habitat. For CofC, a higher value indicates sensitive native species and a higher fidelity to undisturbed Florida systems. In each Region, a "1" indicates the species was present and a "D" or a "C" indicates that the species was Dominant or Co-dominant in the region. Table 3 details the scoring result for the Lake Vegetation Index. Submerged vegetation was commonly observed during the assessment, dominated by *Hydrilla verticillata* with *Vallisneria americana* locally abundant. By analyzing the collected sonar chart,

submerged aquatic vegetation covered approximately 76% of the surface area of Lake Eckles. This submerged vegetation inhabits an estimated 29.26% of the water volume in Lake Eckles.



Figure 5 *Melaleuca quinquenervia* on Lake Eckles.



Figure 6 *Nuphar* was observed among the *hydrilla* on Lake Eckles.

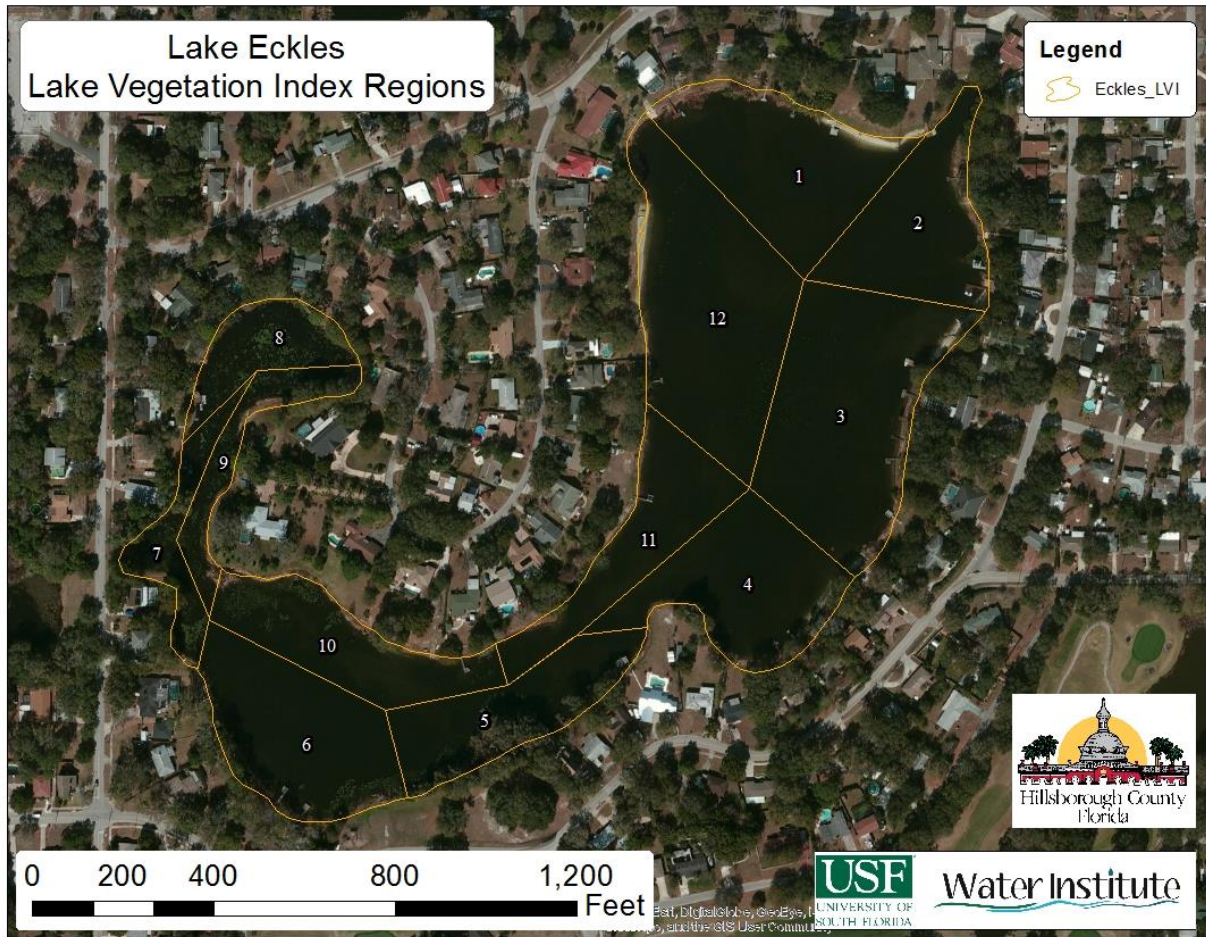


Figure 7 Lake Vegetation Index region map for Lake Eckles.

Table 2 Lake Vegetation Index results for Lake Eckles 7/18/2016

SPECIES	Regions				
	CofC	2	5	8	11
Acer rubrum	4.65	1	1		1
Alternanthera philoxeroides	0.00	1	1	1	1
Bacopa monnieri	3.50				1
Blechnum serrulatum	5.50		1		
Canna flaccida	5.50				1
Casuarina equisetifolia	0.00		1		
Centella asiatica	1.92	1		1	
Colocasia esculenta	0.00			1	
Cyperus alternifolius	0.00	1			
Cyperus odoratus	3.00	1		1	
Cyperus polystachyos	1.56				1
Diodia virginiana	3.00				1
Echinochloa walteri	2.50	1	1		
Eclipta prostrata	2.00	1			
Eleocharis cellulosa	7.80			1	
Fuirena scirpoidea	5.50	1	1	1	1
Hydrilla verticillata	0.00	D	C	C	D
Hydrocotyle	2.00	1	1	1	1
Ilex cassine	6.00			1	
Iris virginica	5.50			1	1
Juncus marginatus	1.50	1			
Ludwigia peruviana	0.00	1		1	1
Ludwigia repens	3.20			1	
Melaleuca quinquenervia	0.00	1	C		
Mikania scandens	1.95	1	1		1
Myrica cerifera	2.00		1		1
Nuphar	3.50	1	1	C	1
Nymphaea odorata	5.00			1	
Osmunda regalis	7.60		1	1	
Oxycaryum cubense	0.50				1
Panicum hemitomon	5.82	1	1	1	1
Panicum repens	0.00	1	1	1	1
Polygonum glabrum	4.50	1		1	1
Polygonum hydropiperoides	2.50			1	
Pontederia cordata	5.38		1		
Quercus laurifolia	4.00	1	1		
Rhexia alifanus	4.60	1			1
Sagittaria lancifolia	3.00	1	1		1
Sagittaria latifolia	3.50				
Salix caroliniana	2.95	1	1		1
Schinus terebinthifolius	0.00				1
Spartina bakeri	5.98				1
Sphagneticola trilobata	0.00	1		1	1
Taxodium	7.00		1	1	1
Typha	1.00		1		1
Utricularia gibba	6.37		1	1	
Vallisneria americana	7.00	1	1	1	1

Table 3 Scoring Summary for the Lake Vegetation Index

LVI Score Summary	Region			
	2	5	8	11
Total # of taxa in sampling unit	24	23	23	27
% Native taxa in sampling unit	70.83333	78.26087	73.91304	74.07407
% FLEPPC CAT 1 taxa in sampling unit	16.66667	17.3913	17.3913	14.81481
% Sensitive taxa in sample unit	4.166667	13.04348	17.3913	7.407407
Dominant CoC in sample unit	0	0	1.75	0
Native Score $((x-62.5)/37.5)$ or $((x-66.67)/25.89)=$	0.160809	0.447697	0.279762	0.285982
Invasive FLEPPC 1 Score $(1 - (x/30))=$	0.444444	0.42029	0.42029	0.506173
Sensitive Score $(x/(27.78 \text{ or } 20)) =$	0.208333	0.652174	0.869565	0.37037
Dominant CoC Score $(x/(7.91 \text{ or } 7)) =$	0	0	0.25	0
Raw Score Total = $N+I+S+D =$	0.813586	1.520161	1.819617	1.162525
Division Factor = $(3 \text{ D}=0 \text{ or } 4) =$	4	4	4	4
Average LVI dividend = Raw /DF	0.203397	0.38004	0.454904	0.290631
South				
LVI Score for sampling unit =	20.33966	38.00401	45.49043	29.06313
Total LVI SCORE =	33			

Water Quality Assessment

Long-term water quality data is available for Lake Eckles through LAKEWATCH volunteers. Additional data was collected as part of this lake assessment. Table 4 provides a summary of the Physical/Chemical conditions recorded at the middle of Lake Eckles.

Table 4 Lake Eckles Water Quality (Field)

Depth (m)	Temp (c)	pH	DO (mg/L)	DO (% Sat)	Cond (umho/cm)	Salinity (ppt)	TDS (mg/L)	Secchi Depth (m)
0.27	32.48	7.41	4.42	59.8	203.3	0.09	130.1	3.2
0.47	32.23	7.09	4.14	55.7	203.9	0.09	130.5	
2.42	31.35	7.06	1.56	20.7	202.4	0.09	129.5	
5.09	26.74	6.79	0	0	205.2	0.09	131.3	

The chemical water quality analysis for Lake Eckles is shown in Table 5 for the sample taken on July 18, 2016. Table 6 includes this data in the numeric nutrient criteria framework using the data from this assessment and the geometric mean values for the past three years for available parameters. Total Phosphorous values were below the nutrient threshold for clear alkaline lakes with sufficient data developed by FDEP of 0.09 mg/l with a three year geometric mean value of 0.019 mg/l. Total Nitrogen values were below the nutrient threshold for clear alkaline lakes with sufficient data developed by FDEP of 1.91 mg/l with a three year geometric mean value of 0.715 mg/l. Chlorophyll-a values are below the nutrient threshold for clear alkaline lakes developed by FDEP of 20.0 µg/l with a three year geometric mean value of 5.59 µg/l.

Bacteria testing showed low levels of Fecal Coliform (28 colonies/100ml) above the rules set forth in FDEP 62-302.530 as well as elevated Enterococci bacteria (500 colonies/100ml) (<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."

Table 5 Lake Eckles Water Quality Results from 7/18/2016 (Laboratory)

Parameter	Value	Units
Alkalinity	52.0	mg/LCaCO ₃
Nitrates/Nitrites	0.009	mg/L
Fecal Coliform	28	#/100 ml
Enterococci	500	#/100 ml
Chlorophyll a	5.5	ug/L
Chlorophyll b	2.6	ug/L
Chlorophyll c	0.7	ug/L
Chlorophyll t	7.4	ug/L
Chlorophylla Corr	4.9	ug/L
Chlorophyll-pheo	6.6	ug/L
Ammonia	0.028	mg/L
Kjeldahl Nitrogen	0.779	mg/L
Total Nitrogen	0.788	mg/L
Total Phosphorus	0.027	mg/L
Color(345)F.45	14.6	Pt/Co

Table 6 NNC Geomeans for the past 3 years for Lake Eckles

Yearly Geomeans	Chlorophyll a (ug/L)	Total Phosphorous (mg/L)	Total Nitrogen (mg/L)	Number of Samples
2014	4.62	0.016	0.673	12
2015	7.09	0.02	0.688	12
2016	5.33	0.02	0.789	3
3-Year Geomean	5.59	0.019	0.715	27

Table 7 Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	14.6
Number of Samples	1
Geometric Mean Alkalinity (mg/L CaCO ₃)	52
Number of Samples	1
Lake Type	Clear Alkaline
Chlorophyll a Criteria (ug/L)	20
Sufficient for Geomean Criteria then P mg/L	0.09
Sufficient for Geomean Criteria then N mg/L	1.91
Three Year Geomean Chla ug/L	5.59
Three Year Geomean TP mg/L	0.019
Three Year Geomean TN mg/L	0.715
Number of Samples	27
Potential Impaired Chlorophyll a	Not Impaired
Potential Impaired TP	Not Impaired
Potential Impaired TN	Not Impaired

Conclusion

The results of the assessment of Lake Eckles shows no impairment based on Total Nitrogen, Total Phosphorous and Chlorophyll-a concentrations according to the FDEP numeric nutrient criteria using the available data. The system shows impairment in the vegetation communities according to the Lake Vegetation Index with moderate overall species, high occurrences and dominance of non-native, invasive species and several sensitive plant species with an overall LVI score of 33. Bacteria sampling also revealed elevated biomass of Enterococci bacteria present at the time of the assessment.

As Lake Eckles responds to the current vegetation treatment it is likely to exhibit a succession of changes to the vegetation community as well as the water quality. Routine monitoring of water quality, as well as the reestablishment of native submerged aquatic vegetation will aid in the recovery of the system.