Lake Carlton

Methods

Study Area Analysis

The watershed containing Lake Carlton 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.

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[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 form 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.

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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 Carlton is located north of highway 674, east of Carlton Lake Rd in Wimauma, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Lake Carlton is dominated by Low Density Residential (36%), Cropland and Pastureland (13.7%), and Cypress (4.1%) land uses. The resulting LDI value for the 100 meter buffer around Lake Carlton is 3.43. The LDI value calculated for the FDEP WBID containing Lake Carlton was 3.25 with approximately 46% of the land use being agricultural and 12% residential.
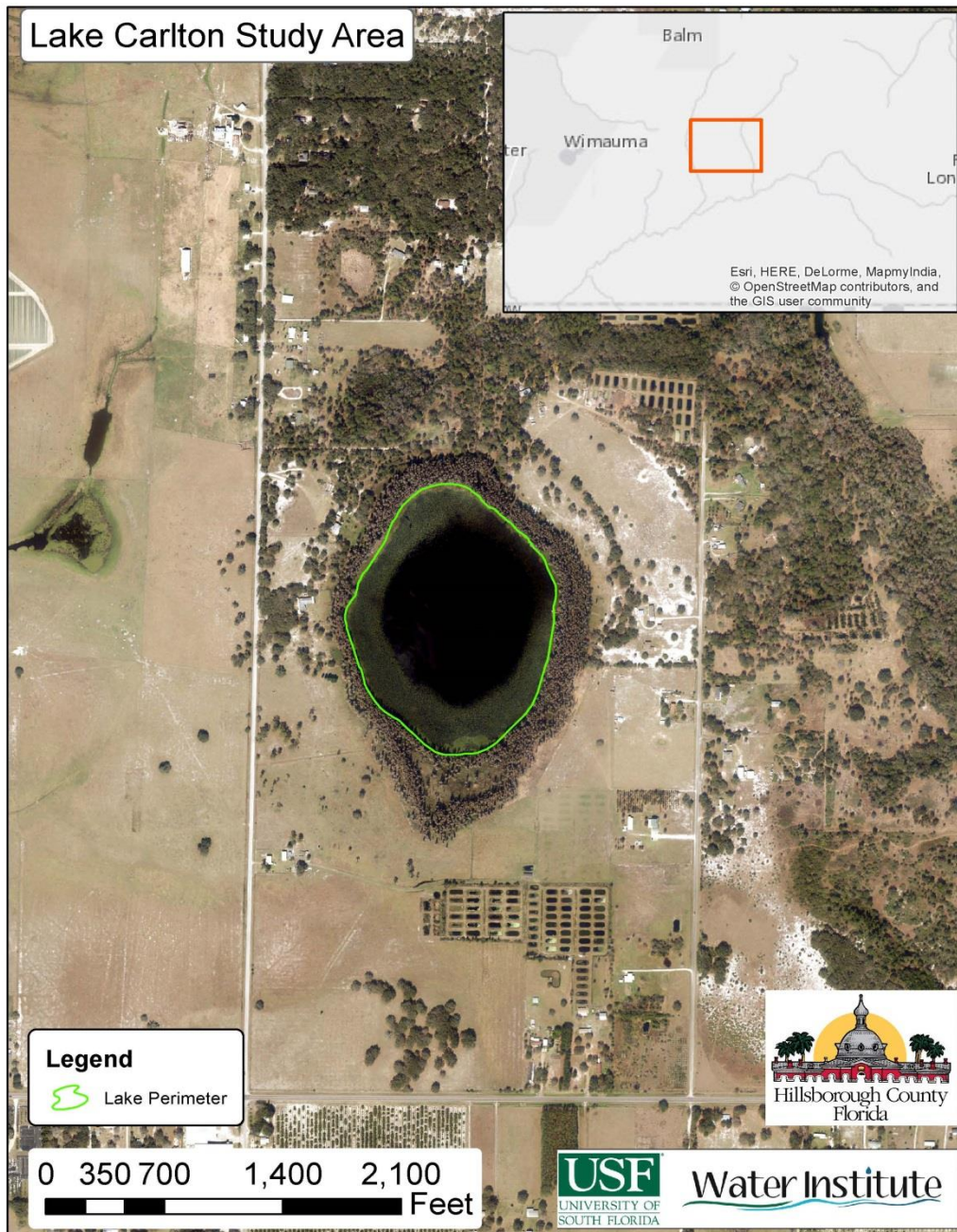
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Figure 1 2016 Lake Carlton Assessment Study Area Map.

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Lake Bathymetry and Morphological Characterization

Lake Carlton at the time of the assessment had a mean water depth of 9.3 feet and a maximum observed depth of 17.02 feet. The volume at this time was approximately 103,283,586 gallons. Figure 2 shows the resulting bathymetric contour map for Lake Carlton from data collected on July 13, 2016. The collected data has been overlain the 2014 Hillsborough County aerials.
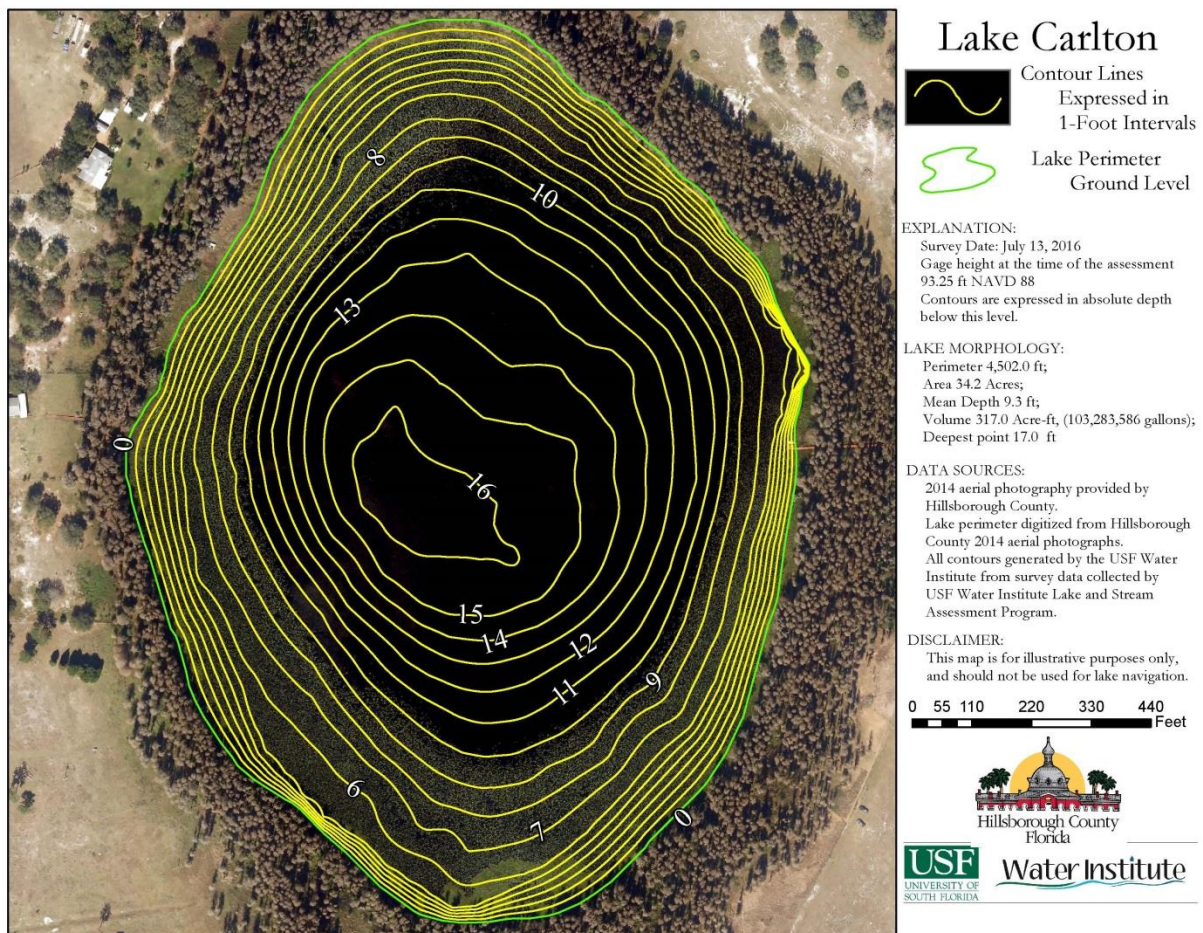

Figure 2 2016 1-Foot Bathymetric Contour Map for Lake Carlton.

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Table 1 Morphological Calculations for Lake Carlton

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	1,487,741	138,214	34.2	0	0
Mean Depth	9.6	2.83	0	0	0
Maximum Depth	17	5.19	0	0	0
Volume (cubic)	13,806,912	390,965	0	317.0	103,283,586
Gauge (relative)	93.25 NAVD 88	28.43	0	0	0

Lake Vegetation Index Assessment

Figure 3 Overview photograph of Lake Carlton.

The lake assessment for Lake Carlton was conducted on July 17, 2016. Lake Carlton received a lake habitat assessment (FEDP form FD 9000-6) score of 103 due to optimal scores for Stormwater Inputs, Lakeside Adverse Human Alterations, Upland Buffer Zone and Adverse Watershed Land Use. Suboptimal scores were recorded for Vegetation Quality. Marginal scores were achieved for Secchi and Bottom Substrate Quality.

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

The Lake Vegetation Index identified 44 species of wetland vegetation growing in the four selected sections along Lake Carlton. The majority of these species (37) are native species. The remaining 7 species (in bold on Table 2) are non-native and invasive to this region. The vegetation community along Lake Carlton is dominated by a variety of emergent species including *Taxodium* and *Oxycaryum cubense* (Figure 4). The water's surface in Lake Carlton was dominated by *Nuphar* and *Salvinia minima* (Figure 5 and 6). The calculated LVI score for Lake Carlton was 56, above the impairment threshold of 37. Figure 7 shows the map of Lake Carlton detailing the LVI regions used for the assessment. Table 2 details the species list results of the Lake Vegetation Index. Table 3 details the scoring result for the Lake Vegetation Index. Submerged vegetation (*Mayaca fluviatilis*) was observed during the assessment. By analyzing the collected sonar chart, submerged aquatic vegetation covered approximately 14% of the surface area of Lake Carlton. This submerged vegetation inhabits an estimated 3.1% of the water volume in Lake Carlton. Submerged vegetation is limited in Lake Carlton at the current water levels due to shading by the emergent rim of *taxodium* and *nuphar.*

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Figure 5 *Nuphar* on Lake Carlton.

Figure 6 *Salvinia minima* on Lake Carlton.

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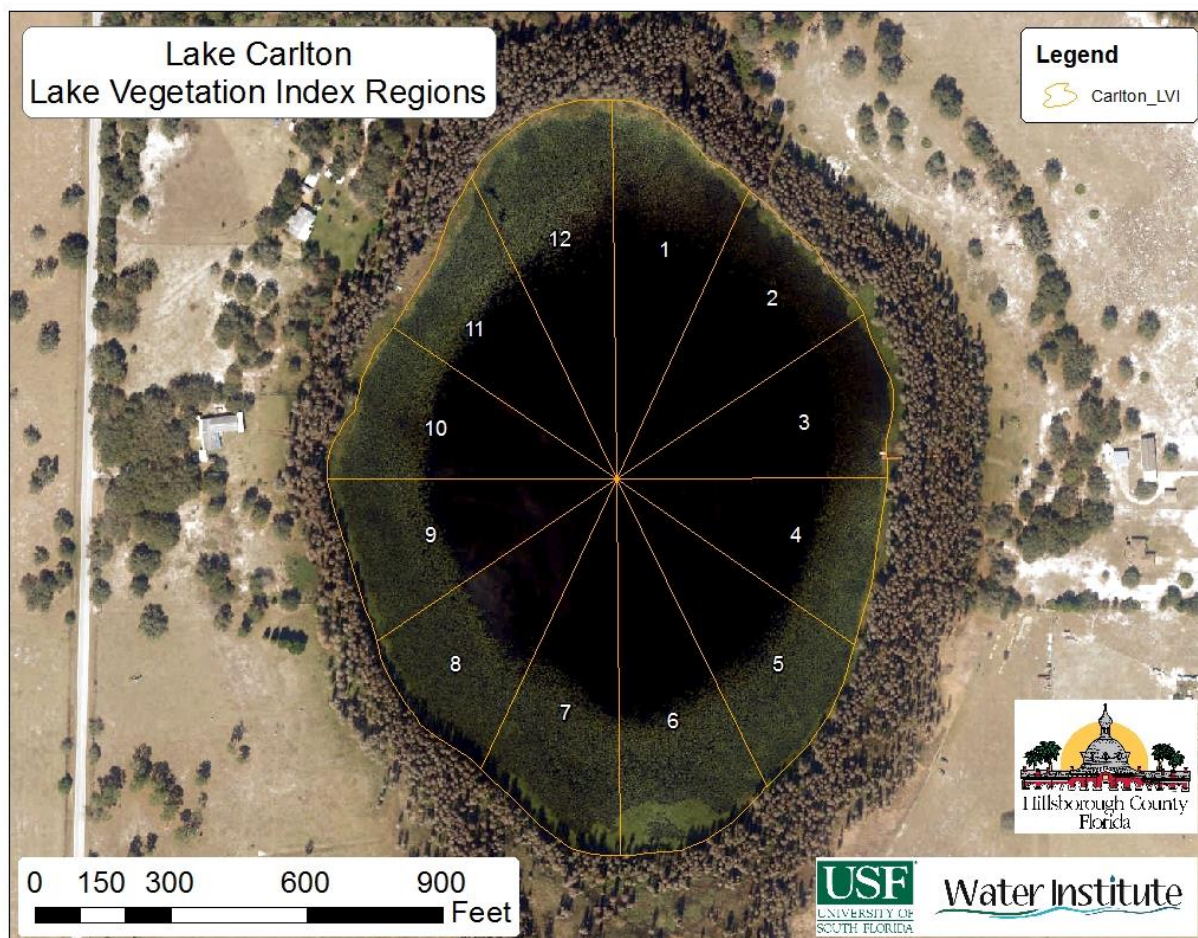
Figure 7 Lake Vegetation Index region map for Lake Carlton.

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Table 2 Lake Vegetation Index results for Lake Carlton 7/13/2016

SPECIES		Region			
	CofC	1	4	7	10
Acer rubrum	4.65	1	1	1	1
Blechnum serrulatum	5.50	1	1	1	1
Cephalanthus occidentalis	5.00	1	1	1	1
Ceratopteris thalictroides	2.93	1	1	1	1
Myrica cerifera	2.00	1	1	1	1
Salvinia minima	0.00	1	1	1	1
Utricularia gibba	6.37	1	1	1	1
Taxodium	7.00	c	c	c	1
Nuphar	3.50	c	c	c	c
Oxycaryum cubense	0.50	1	1	1	c
Boehmeria cylindrica	5.00	1	1		1
Eleocharis baldwinii	2.82		1	1	1
Hydrocotyle	2.00	1	1		1
Lemna	1.00	1	1		1
Ludwigia peruviana	0.00	1	1		1
Mayaca fluviatilis	8.45	1		1	1
Mikania scandens	1.95		1	1	1
Polygonum hydropiperoides	2.50	1		1	1
Pontederia cordata	5.38	1		1	1
Sacciolepis striata	5.35	1		1	1
Commelina diffusa	2.02	1			1
Ilex cassine	6.00	1	1		
Magnolia virginiana	7.00		1	1	
Sapium sebiferum	0.00		1	1	
Toxicodendron radicans	1.44	1	1		
Urochloa mutica	0.00	1			1
Woodwardia virginica	3.50		1		1
Acmella oppositifolia repens	3.00				1
Cyperus odoratus	3.00			1	
Cyperus polystachyos	1.56				1
Cyperus surinamensis	2.03				1
Juncus effusus	2.00				1
Leersia hexandra	5.61				1
Limnobium spongia	2.50				1
Ludwigia arcuata	3.50				1
Luziola fluitans	4.00				1
Lycopus rubellus	4.00				1
Micranthemum umbrosum	5.66	1			
Osmunda cinnamomea	6.44		1		
Persea palustris	7.00		1		
Pluchea foetida	6.65				1
Salix caroliniana	2.95			1	
Symphyotrichum carolinianum	3.93			1	
Triadenum virginicum	5.00				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	21	34
% Native taxa in sampling unit	73.91304	78.26087	80.95238	82.35294
% FLEPPC CAT 1 taxa in sampling unit	13.04348	13.04348	9.52381	8.823529
% Sensitive taxa in sample unit	8.695652	13.04348	14.28571	5.882353
Dominant CoC in sample unit	5.25	5.25	5.25	2

	1	4	7	10
Native Score ((x-62.5)/37.5) or ((x-66.67)/25.89)=	0.279762	0.447697	0.551656	0.605753
Invasive FLEPPC 1 Score (1 - (x/30))=	0.565217	0.565217	0.68254	0.705882
Sensitive Score (x/(27.78 or 20)) =	0.434783	0.652174	0.714286	0.294118
Dominant CoC Score (x/(7.91 or 7)) =	0.75	0.75	0.75	0.285714
Raw Score Total = N+I+S+D =	2.029762	2.415088	2.698482	1.891467
Division Factor = (3 D=0 or 4) =	4	4	4	4
Average LVI dividend = Raw /DF South	0.507441	0.603772	0.67462	0.472867
LVI Score for sampling unit =	50.74406	60.3772	67.46204	47.28668
Total LVI SCORE =	56			

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Water Quality Assessment

Long-term water quality data is not available for Lake Carlton. 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 Lake Carlton.

Table 4 Lake Carlton Water Quality (Field)

Depth (m)	Temp (C)	pH	DO (mg/L)	DO (% SAT)	Cond (umho/cm)	Salinity (ppt)	TDS (mg/L)	Secchi Depth (m)
0.32	30.08	5.13	3.07	39.9	48.1	0.03	30.8	1.1
0.34	29.78	5.27	3.2	41.3	48.2	0.03	30.8	
1.23	29.38	5.12	2.93	37.6	47.9	0.02	30.6	
2.46	25.45	5.44	0	0	64.6	0.03	41.3	
4.73	20.65	5.45	0	0	74.7	0.03	47.8	

The chemical water quality analysis for Lake Carlton is shown in Table 5 for the sample taken on July 13, 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 colored lakes with insufficient data developed by FDEP of 0.05 mg/l with a value of 0.054 mg/l. Total Nitrogen values were below the nutrient threshold for colored lakes with insufficient data developed by FDEP of 1.27 mg/l with a value of 0.870 mg/l. Chlorophyll-a values are above the nutrient threshold for colored lakes developed by FDEP of 20.0 µg/l with a value of 22.1 µg/l. It should be noted that these thresholds for Total Nitrogen and Total Phosphorous are for lakes with insufficient data for calculating annual geometric means. If sufficient data were to be collected, the thresholds could be raised to 0.16 mg/l for Total Phosphorous and 2.23 mg/l for Total Nitrogen.

Bacteria testing showed levels of Fecal Coliform (80colonies/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."

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Table 5 Lake Carlton Water Quality Results from 7/13/2016 (Laboratory)

Parameter	Value	Units
Turbidity	5.1	NTU
Alkalinity	8.0	mg/LCaCO3
Nitrates/Nitrites	0.003	mg/L
Fecal Coliform	80	#/100 ml
Enterococci	100	#/100 ml
Chlorophyll a	27.2	ug/L
Chlorophyll b	5.7	ug/L
Chlorophyll c	1.7	ug/L
Chlorophyll t	34.6	ug/L
Chlorophylla Corr	22.1	ug/L
Chlorophyll-pheo	7.8	ug/L
Ammonia	0.006	mg/L
Kjeldahl Nitrogen	0.867	mg/L
Total Nitrogen	0.870	mg/L
Total Phosphorus	0.054	mg/L
Color(345)F.45	49.6	Pt/Co

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Table 6 Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	49.6
Number of Samples	1
Geometric Mean Alkalinity (mg/L CACO3)	8
Number of Samples	1
Lake Type	Colored Acidic
Chlorophyll a Criteria (ug/L)	20
Insufficient for Geomean Criteria then P mg/L	0.05
Insuffcient for Geomean Criteria then N mg/L	1.27
Geomean Chla ug/L	22.1
Geomean TP mg/L	0.054
Geomean TN mg/L	0.870
Number of Samples	1
Potential Impaired Chlorophyll a	Impaired
Potential Impaired TP	Impaired
Potential Impaired TN	Not Impaired

Conclusion

The results of the assessment of Lake Carlton shows potential impairment based on Total Phosphorous and Chlorophyll-a 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 does not show impairment in the vegetation communities according to the Lake Vegetation Index with high overall species, moderate occurrences of non-native, invasive species and several sensitive plant species with an overall LVI score of 56. Bacteria sampling also revealed low biomass of Fecal Coliform bacteria present at the time of the assessment.