Lake Stemper

LAKE HABITAT ASSESSMENT, LAKE VEGETATION IDEX, SUBMERGED VEGETATION SURVEY AND WATER QUALITY

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Methods

STUDY AREA ANALYISIS

The watershed containing Lake Stemper was analyzed using ESRI ArcGIS 10.2. Using this software with 2011 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 Reiss & Brown 2012(Reiss & Brown. 2012. Landscape Development Intensity (LDI) Index User's Manual. H.T. Odum Center for Wetlands, University of Florida. March 2012). According to Reiss and Brown "The LDI represents a human disturbance gradient for wetland systems. The LDI is an integrated measure of human activity, combining the effects from air and water pollutants, physical damage, changes in the suite of environmental conditions … on the structure and processes of landscapes and ecosystems… Natural, undeveloped LU/LC classes have a LDI index value of one. In the Florida framework, the maximum LDI index score is approximately 42."

The LDI is calculated by multiplying each land use coefficient by the percentage of the area of interest occupied by that land use, and then summing the results. The Florida Department of Environmental Protection (DEP) uses the LDI as a tool to estimate potential land use impacts on streams, lakes, and wetlands. LDI values less than two (≤ 2) can be considered minimally disturbed."

LAKE BATHYMETRY AND MORPHOLOGICAL CHARACTERISTICS ASSESSMENT

The Bathymetric Map[1] 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)[2] 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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[1] 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.

[2] 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.

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.

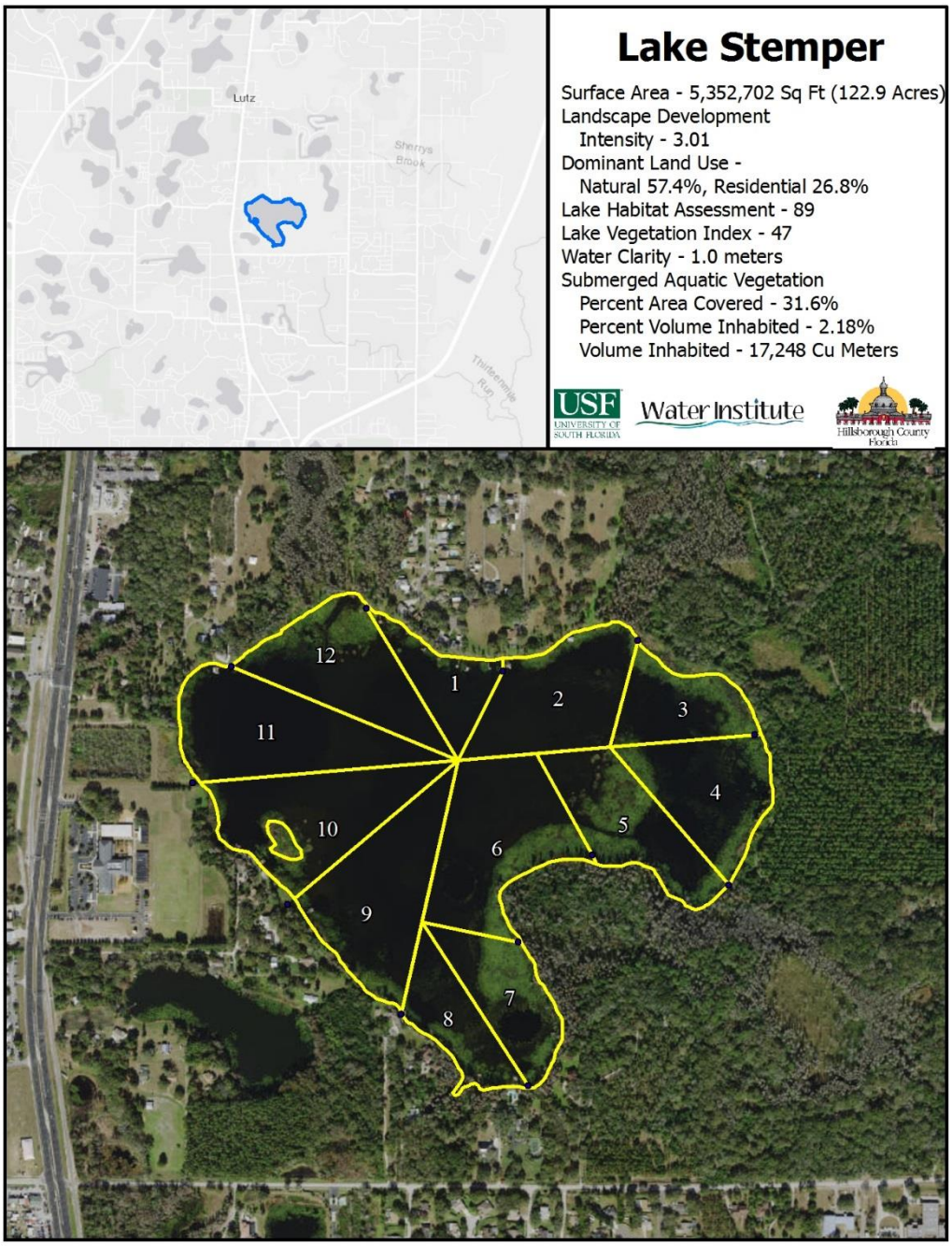
WATER QUALITY ASSESSMENT

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, EColi, 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 Stemper is located south of Sunset Lane in the Lutz area of Hillsborough County, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Lake Stemper is dominated by Natural (57.4%) and Residential (26.8%) land uses. The resulting LDI value for the 100 meter buffer around Lake Stemper is 3.01.

FIGURE 1: 2018 LAKE STEMPER ASSESSMENT STUDY AREA MAP



Lake Bathymetry and Morphological Characterization

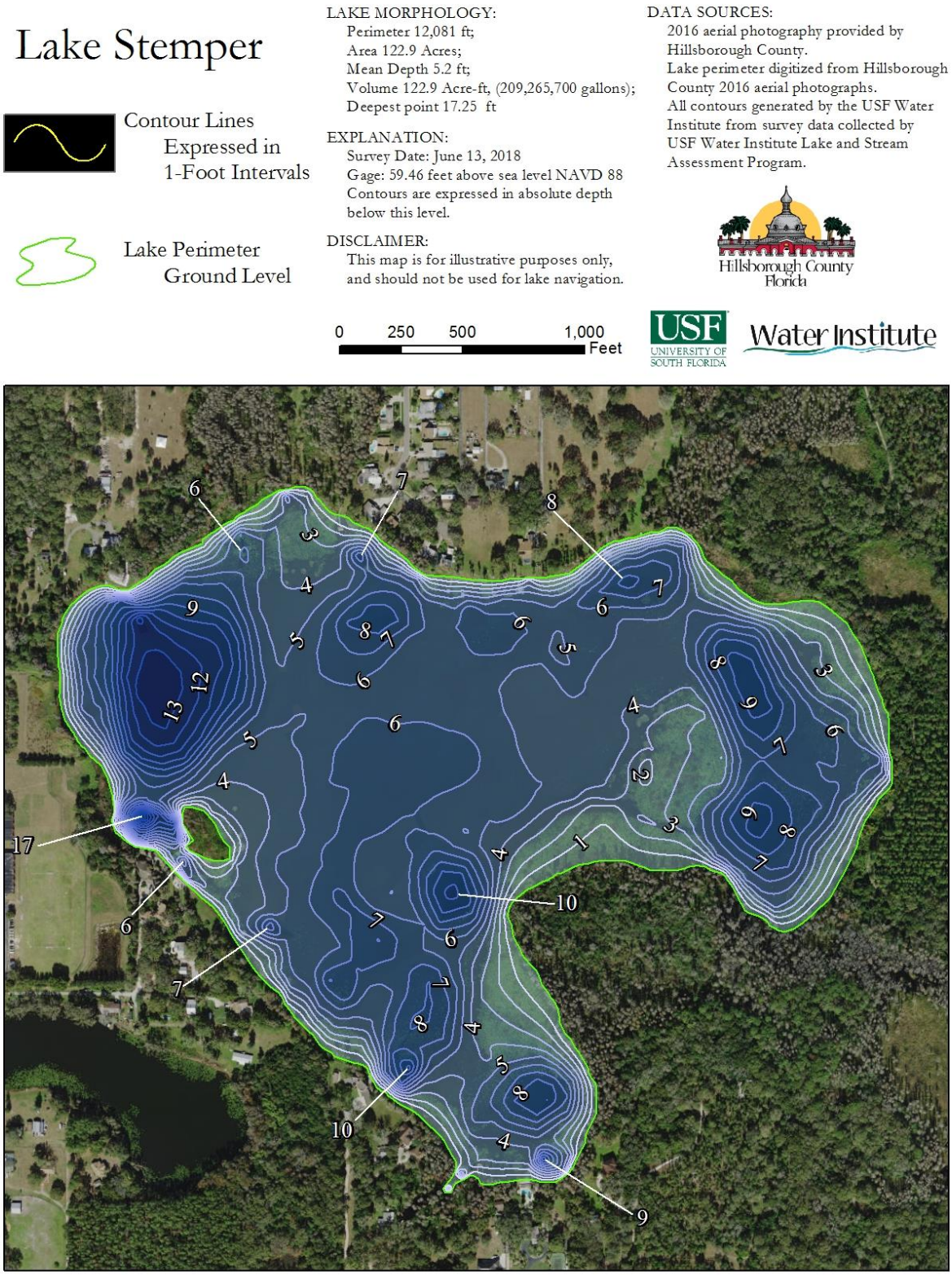
Lake Stemper is a shallow system that has been somewhat altered in the past due to dredge and fill operations prior to residential construction. The evidence from this activity is shown as the series of deep holes along the shoreline. The deepest depth in the lake was 17.25 feet deep.

At the time of the assessment, Lake Stemper was experiencing normal water levels (61.27 feet above sea level NAVD 88) resulting in a 122.9 acre water body. Lake Stemper at the time of the assessment had a mean water depth of 5.23 feet and a maximum observed depth of 17.25 feet. The volume at this time was approximately 209,265,700 gallons. Figure 2 shows the resulting bathymetric contour map for Lake Stemper from data collected on June 13, 2018. The collected data has been overlain the 2016 Hillsborough County aerials.

Table 1: Morphological Calculations for Lake Stemper

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	5,352,702	497,278	122.9		
Mean Depth	5.23	1.59			
Maximum Depth	17.25	5.26			
Volume (cubic)	27,974,561	792,144		642.2	209,265,700
Gauge (NAVD 88)	59.46	18.12			

Figure 2: 2017 1-Foot Bathymetric Contour Map for Lake Stemper



Lake Habitat and Lake Vegetation Index Assessment

Figure 3 Overview photograph of Lake Stemper showing typical shoreline vegetation.

The lake assessment for Lake Stemper was conducted on June 13, 2018. Lake Stemper received a lake habitat assessment (FEDP form FD 9000-6) score of 89 due to optimal scores for Adverse Watershed Land Use, suboptimal scores for Vegetation Quality, Stormwater Inputs, Upland Buffer Zone and Lakeside Adverse Human Alterations. Marginal scores were achieved for Bottom Substrate Quality and Secchi.

The water in Lake Stemper was characterized as somewhat tannic and slightly turbid with a mean color value of 32.45 PCU. The secchi disk depth was 1.0 meters in part due to the tannins and turbidity. The vegetation quality of the plants in and buffering Lake Stemper are predominantly native species with moderate growths of non-native nuisance species such as *panicum repens*. Some direct inputs of stormwater were noted through pipes and ditches to the lake. The bottom substrate quality was dominated by sand with coarse particulate organic matter near shore and some accumulation of muck. Approximately 26.8% of the surrounding land has been developed for residential housing including several docks. Some homeowners have maintained an upland buffer zone along the shoreline while others have removed this vegetation for turf grass lawns.

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

The Lake Vegetation Index identified 51 species of wetland vegetation growing in the four selected sections (Regions 3, 6, 9, 12) along Lake Stemper. The majority of these species (42) are native species. The remaining 9 species (*Panicum repens*, Casurina equisetifolia, Melaleuca quinquenervia, *Alternanthera philoxeroides, Oxycaryum cubense, Sphagneticola trilobata, Colocasia esculenta, Schinus terebinthifolius* and *Ludwigia peruviana*) are non-native and invasive to this region. The vegetation community along Lake Stemper is dominated by a variety of emergent species including *Panicum repens, Taxodium and Ludwigia peruviana.* The water's surface in Lake Stemper was dominated by Nymphaea odorata and *Nuphar* (Figure 5).

A total of 5 species of submerged aquatic vegetation was observed, *Eleocharis baldwinii, Nitella, Utricularia gibba, Utricularia foliosa* and *Utricularia radiata.* By analyzing the collected sonar chart, submerged aquatic vegetation potentially covered approximately 31.55%% of the surface area Lake Stemper. This submerged vegetation inhabits an estimated 2.18% of the water volume in Lake Stemper. Figure 6 shows the results of the SAV analysis indicating the location and percent of the water column inhabited by SAV.

The calculated LVI score for Lake Stemper was 47, above the impairment threshold of 37. Figure 7 shows the map of Lake Stemper detailing the LVI regions used for the assessment (Regions 3, 6, 9, 12). Table 2 details the species list results of the Lake Vegetation Index. Table 3 details the scoring result for the Lake Vegetation Index.

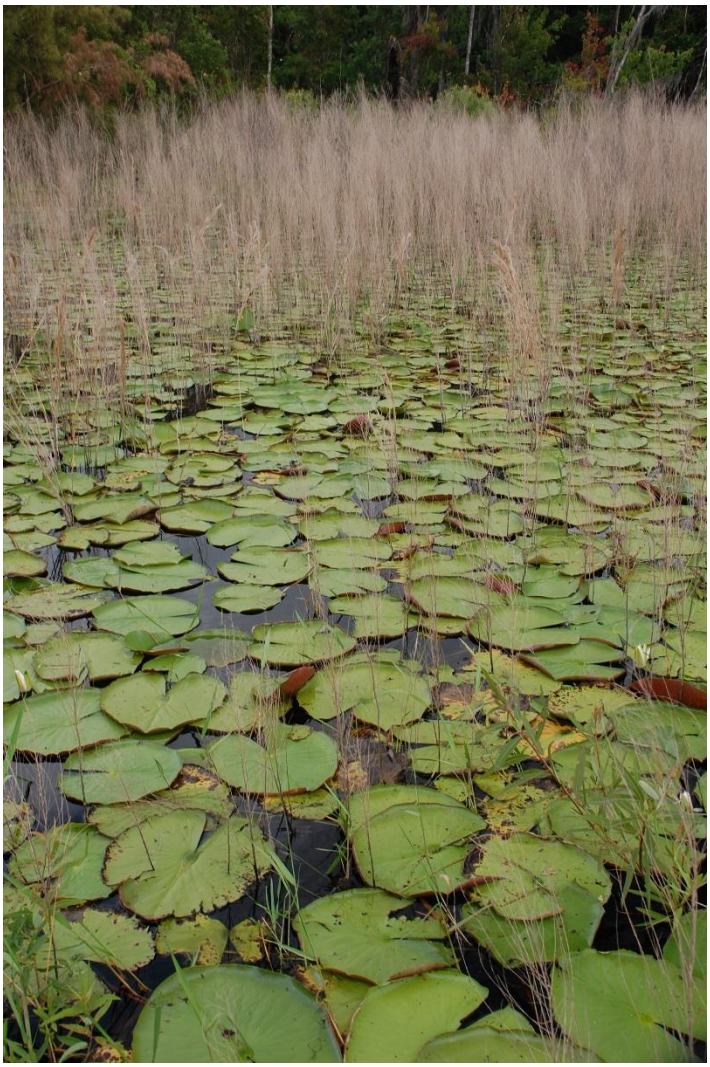


Figure 5 Nymphaea odorata dominated the water surface in Lake Stemper

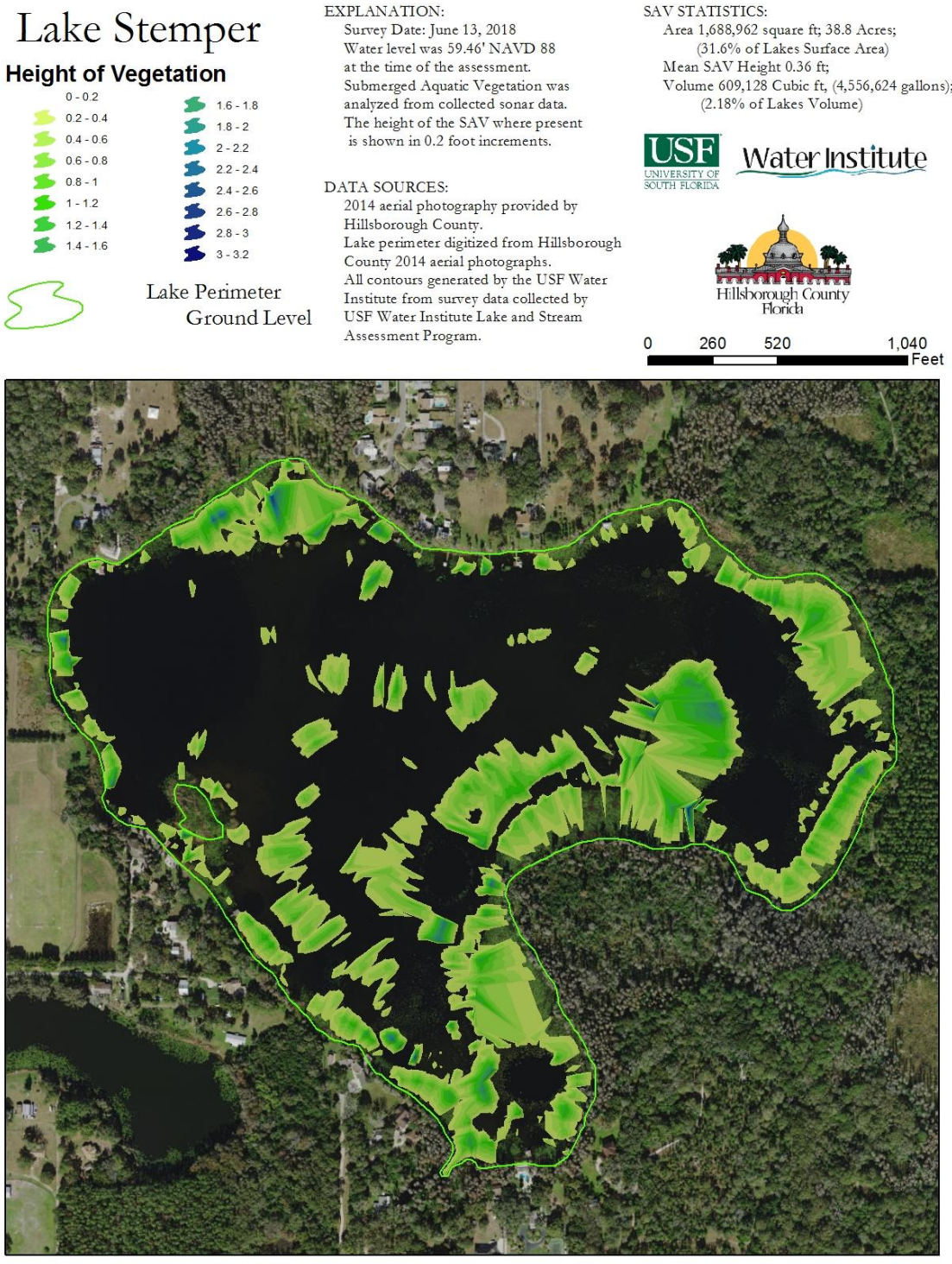


Figure 6 Lake Commiston Submerged Aquatic Vegetation Assessment Results

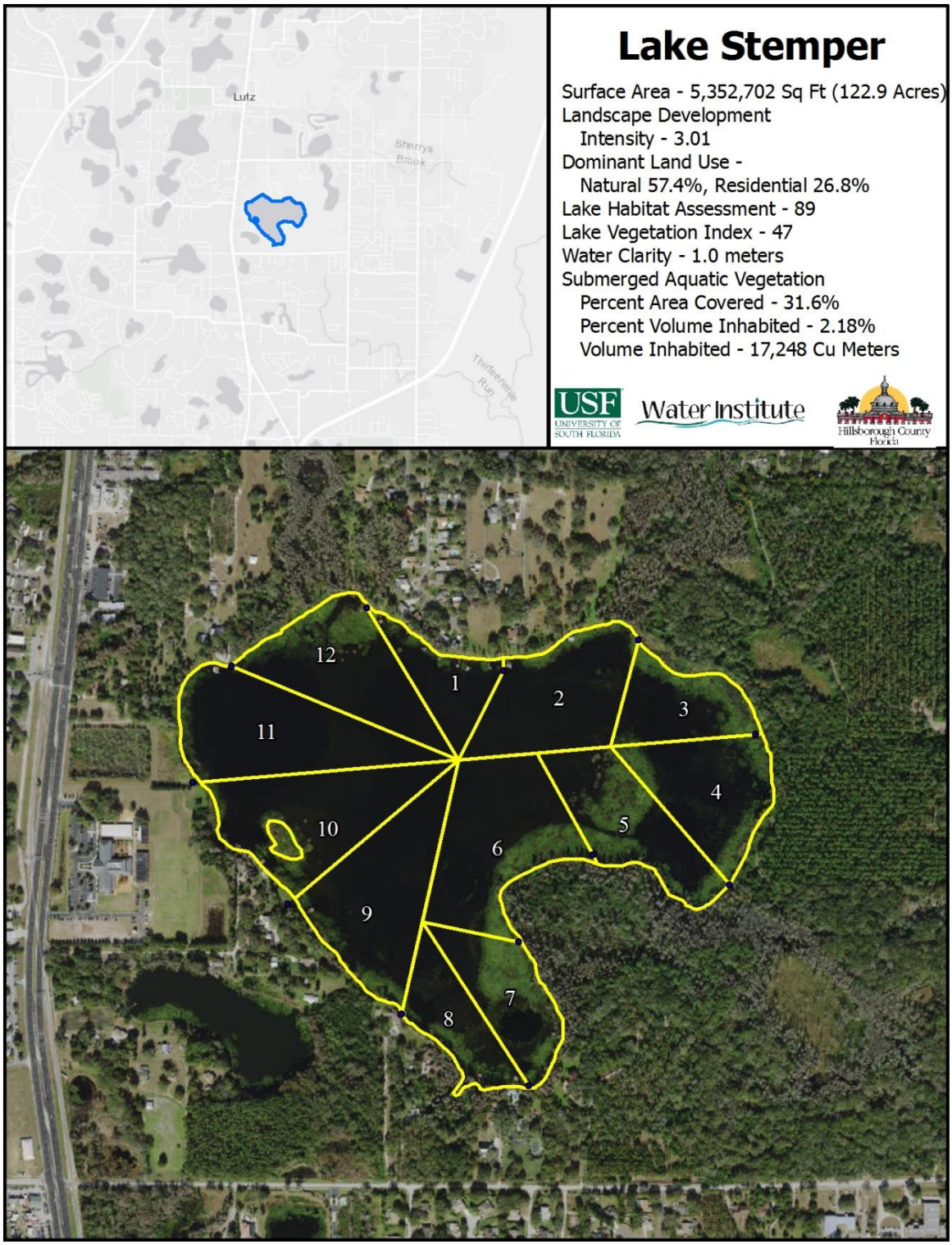


Figure 7: Lake Vegetation Index region map for Lake Stemper

Table 2: Lake Vegetation Index results for Lake Stemper 6/13/2018 (continued on next page)

		Region			
SPECIES	**CofC**	**3**	**6**	**9**	**12**
Acer rubrum	4.65	**1**	**1**	**1**	**1**
Alternanthera philoxeroides	0.00	**1**	**1**	**1**	**1**
Blechnum serrulatum	5.50	**1**	**1**	**1**	**1**
Boehmeria cylindrica	5.00	**1**	**1**	**1**	**1**
Casuarina equisetifolia	0.00	**1**	**1**	**1**	**1**
Cephalanthus occidentalis	5.00	**1**	**1**	**1**	**1**
Colocasia esculenta	0.00	**1**	**1**	**1**	**1**
Melaleuca quinquenervia	0.00	**1**	**1**	**1**	**1**
Myrica cerifera	2.00	**1**	**1**	**1**	**1**
Nuphar	3.50	**1**	**1**	**1**	**C**
Nymphaea odorata	5.00	**D**	**D**	**C**	**C**
Panicum hemitomon	5.82	**1**	**1**	**1**	**1**
Panicum repens	0.00	**1**	**1**	**1**	**1**
Paspalidium geminatum	5.50	**1**	**1**	**1**	**1**
Pontederia cordata	5.38	**1**	**1**	**1**	**1**
Salix caroliniana	2.95	**1**	**1**	**1**	**1**
Schinus terebinthifolius	0.00	**1**	**1**	**1**	**1**
Taxodium	7.00	**1**	**1**	**1**	**1**
Typha	1.00	**1**	**1**	**1**	**1**
Utricularia gibba	6.37	**1**	**1**	**1**	**1**
Eleocharis baldwinii	2.82	**1**	**1**	**1**	
Ludwigia peruviana	0.00	**1**		**1**	**1**
Lycopus rubellus	4.00	**1**	**1**		**1**
Utricularia radiata	6.01	**1**	**1**	**1**	
Vitis rotundifolia	1.18		**1**	**1**	**1**
Eupatorium capillifolium	0.83	**1**		**1**	
Fuirena scirpoidea	5.50	**1**		**1**	
Gordonia lasianthus	7.00	**1**	**1**		
Hydrocotyle	2.00			**1**	**1**
Juncus megacephalus	3.50	**1**		**1**	
Mikania scandens	1.95			**1**	**1**

		Region			
SPECIES	**CofC**	**3**	**6**	**9**	**12**
Oxycaryum cubense	0.50		**1**		**1**
Persea palustris	7.00		**1**		**1**
Quercus laurifolia	4.00	**1**	**1**		
Sphagneticola trilobata	0.00			**1**	**1**
Utricularia foliosa	5.00		**1**	**1**	
Acer saccharinum	6.89			**1**	
Ceratophyllum demersum	4.16			**1**	
Cyperus odoratus	3.00				**1**
Cyperus surinamensis	2.03			**1**	
Diodia virginiana	3.00			**1**	
Eleocharis cellulosa	7.80		**1**		
Juncus marginatus	1.50			**1**	
Lachnanthes caroliniana	3.76			**1**	
Liquidambar styraciflua	2.50				**1**
Ludwigia arcuata	3.50				**1**
Magnolia virginiana	7.00				**1**
Nitella	6.00			**C**	
Rhexia alifanus	4.60			**1**	
Rubus trivialis	2.60		**1**		
Sagittaria lancifolia	3.00				**1**

Table 3: Scoring Summary for the Lake Vegetation Index

LVI Score Summary	**Region**			
	3	**6**	**9**	**12**
Total # of taxa in sampling unit	29	31	39	33
% Native taxa in sampling unit	75.86207	77.41935	79.48718	72.72727
% FLEPPC CAT 1 taxa in sampling unit	20.68966	16.12903	15.38462	18.18182
% Sensitive taxa in sample unit	6.896552	12.90323	2.564103	9.0909
Dominant CoC in sample unit	5	5	5.5	4.25
Native Score ((x-62.5)/37.5) or ((x-66.67)/25.89)=	0.355043	0.415193	0.495063	0.233962
Invasive FLEPPC 1 Score (1 - (x/30))=	0.310345	0.462366	0.487179	0.393939
Sensitive Score (x/(27.78 or 20)) =	0.344828	0.645161	0.128205	0.454545
Dominant CoC Score (x/(7.91 or 7)) =	0.714286	0.714286	0.785714	0.607143
Raw Score Total = N+I+S+D =	1.724501	2.237006	1.896162	1.68959
Division Factor = (3 D=0 or 4) =	4	4	4	4
Average LVI dividend = Raw /DF	0.431125	0.559251	0.47404	0.422397
South				
LVI Score for sampling unit =	43.11253	55.92515	47.40405	42.23974

Total LVI SCORE = 47

Water Quality Assessment

Limited long-term water quality data is available for Lake Stemper. The majority of the available data was collected as part of the University of Florida LAKEWATCH program (1996-2017) as well as FDEP and Hillsborough County Stormwater. Table 4 provides a summary of the Physical/Chemical conditions recorded at the middle of Lake Stemper.

Table 4: Lake Stemper Water Quality (Field)

Depth (m)	Temp °C	pH	DO (mg/L)	DO (%sat)	Cond (unho/cm)	Salinity (ppt)	Secchi Depth (m)
0.05	29.44	8.82	7.29	94.1	159	0.07	1.0
1.18	26.62	8.41	6.84	84	158	0.07	
3.64	25.58	8.24	2.68	32.3	159	0.07	
POR	14.19	7.19	8.66		217	0.1	1.21

The chemical water quality analysis for Lake Stemper is shown in Table 5 for the sample taken on June 13, 2018. Table 6 includes this data in the numeric nutrient criteria framework using the data from this assessment as well as the available LAKEWATCH geometric mean values for the period of record since complete data for the past three years for available parameters is not available. Total Phosphorous values were below the nutrient threshold for colored lakes in the west central region with insufficient data developed by FDEP of 0.49 mg/l with a value of 0.020 mg/l for the POR and below the threshold for the single sample with a value of 0.059 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 0.933 mg/l for the POR data. The Total Nitrogen value associated with the sample for this assessment was 0.636 mg/l. Chlorophyll-a corrected values are below the nutrient threshold for colored lakes developed by FDEP of 20.0 µg/l with a value of 4.0 µg/l. The UF LAKEWATCH data is for uncorrected chlorophyll-a and has a mean value for the period of record of 10.43 µg/l.

Bacteria testing showed low levels of E. Coli (8 colonies/100ml) and Enterococci (20 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."

Table 5: Lake Stemper Water Quality Results from 6/14/18 (Laboratory)

Parameter	Lake Stemper (Center)	POR Mean Value	Units
Alkalinity	34.0		mg/LCaCO3
Nitrates/Nitrites	0.011	0.014	mg/L
E. Coli	8	72	#/100 ml
Enterococci	20	2	#/100 ml
Chlorophyll a	4.4	10.43	ug/L
Chlorophyll b	5.1		ug/L
Chlorophyll c	0.7		ug/L
Chlorophyll t	7.8		ug/L
Chlorophylla Corr	4.0	1.49	ug/L
Chlorophyll-pheo	3.2		ug/L
Ammonia	0.008	0.008	mg/L
Kjeldahl Nitrogen	0.636	0.77	mg/L
Total Nitrogen	0.636	0.933	mg/L
Total Phosphorus	0.059	0.020	mg/L
Color(345)F.45	12.0	52.9	Pt/Co

Table 6: Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	32.45
Number of Samples	2
Geometric Mean Alkalinity (mg/L $CACO_3$)	34.0
Number of Samples	1
Lake Type	Colored Alkaline
Chlorophyll a Criteria (ug/L)	20
Insufficient for Geomean Criteria then P mg/L	0.03
Insuffcient for Geomean Criteria then N mg/L	1.05
Geomean Chla ug/L	1.49
Geomean TP mg/L	0.020
Geomean TN mg/L	0.933
Number of Samples	267
Potential Impaired Chlorophyll a	Not Impaired
Potential Impaired TP	Not Impaired
Potential Impaired TN	Not Impaired

Conclusion

The results of the assessment of Lake Stemper shows a healthy lake based on Total Nitrogen, Total Phosphorous and Chlorophyll concentrations according to the FDEP numeric nutrient criteria using the single sample taken during this assessment and limited long term water quality record. The sampling data was insufficient to calculate proper FDEP Numeric Nutrient Criteria values. Consistent Long term sampling would be necessary to determine actual NNC values. The system also shows health in the vegetation communities according to the Lake Vegetation Index with moderate overall species (51), lower occurrences of non-native, invasive species and several sensitive plant species with an overall LVI score of 47. The assessment also revealed a significant submerged aquatic vegetation community comprising 5 species occupying 31.55% of the surface area and 2.18% of the volume of Lake Stemper.