Lake LeClare

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

David Eilers, David McIlwaine, Kristina O'Keefe, Julie Lam, Jonathon Chapin | USF Water Institute | May 28, 2019

Methods

STUDY AREA ANALYISIS

The watershed containing the Lake LeClare was analyzed using ESRI ArcGIS 10.6. Using this software with 2017 Hillsborough County aerial, 2014 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 Elite 7 Ti Wide Area Augmentation System (WAAS)[2] enabled Global Positioning System (GPS) with Totalscan transducer (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.

[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 43.

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.

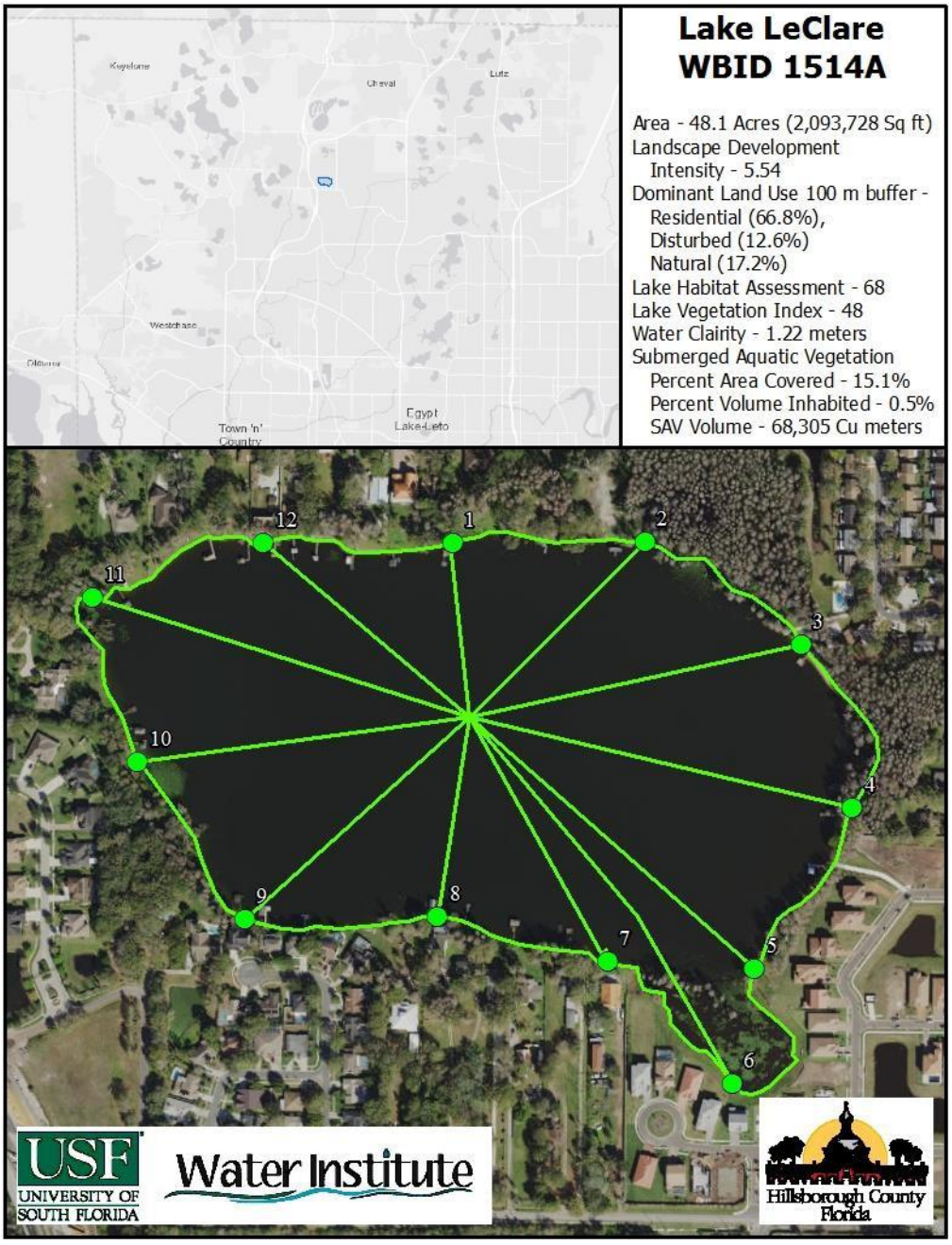
WATER QUALITY ASSESSMENT

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 LeClare is located in north-western Hillsborough County, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Lake LeClare is dominated by Residential (66.8%), Natural (17.2%), Disturbed Lands (12.6%) and Reservoirs (3.4%) land uses. The resulting LDI value for the 100 meter buffer around Lake LeClare is 5.54.

FIGURE 1: 2019 LAKE LECLARE ASSESSMENT STUDY AREA MAP



Lake Bathymetry and Morphological Characterization

At the time of the assessment, Lake LeClare was experiencing elevated water levels (49.59 feet above sea level NAVD 88) resulting in a 48.1 acre water body. Lake LeClare at the time of the assessment had a mean water depth of 7.17 feet and a maximum observed depth of 18.53 feet. The volume at this time was approximately 112,338,072 gallons. Figure 2 shows the resulting bathymetric contour map for Lake LeClare from data collected on May 23, 2019. The collected data has been overlain the 2017 Hillsborough County aerials.

Table 1: Morphological Calculations for Lake LeClare

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	2,093,728	194,512,	48.1		
Mean Depth	7.17	2.19			
Maximum Depth	18.53	5.65			
Volume (cubic)	15,017,312	425,239		344.8	112,338,072
Gauge (NAVD 88)	49.59	15.12			

Figure 2: 2019 1-Foot Bathymetric Contour Map for Lake LeClare

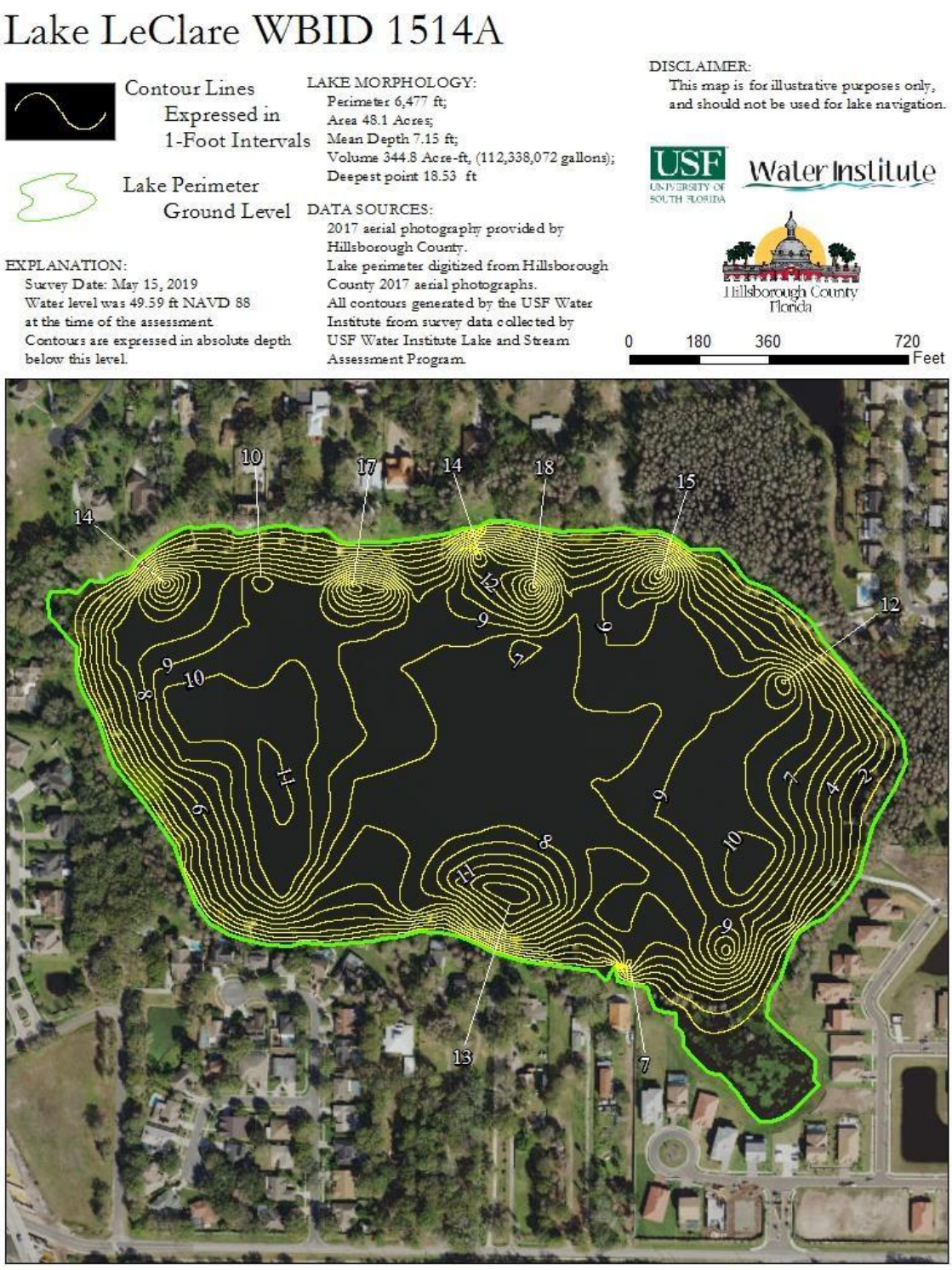


Figure 3 Overview photograph of Lake LeClare showing typical shoreline vegetation in an undeveloped area.

Lake Habitat and Lake Vegetation Index Assessment

The lake assessment for Lake LeClare was conducted on May 23, 2019. The water in Lake LeClare was characterized as moderately tannic and moderately turbid with a color value of 20.4 PCU. The secchi disk depth was 1.22 meters in part due to the high tannins and turbidity. The vegetation quality of the plants in and buffering Lake LeClare are predominantly native species with moderate growths of non-native nuisance species such as *Schinus terebinthifolius, Panicum repens and Melaleuca quinquenervia*. Some direct inputs of stormwater were noted through pipes and ditches to the lake, but most stormwater reaches the lake via sheet flow. The bottom

substrate quality was dominated by sand with coarse particulate organic matter near shore and some accumulation of muck. Approximately 66.8% of the surrounding land has been developed for residential housing including several docks and seawalls. Some homeowners have maintained a vegetated buffer zone along the shoreline.

Figure 4 Cephalanthus occidentalis, Common Buttonbush, along a vegetated section of Lake LeClare's shoreline.

The Lake Vegetation Index identified 49 species of wetland vegetation growing in the four selected sections along Lake LeClare. The majority of these species (38) are native species. The remaining 11 species (*Panicum repens*, *Alternanthera philoxeroides, Eichhornia crassipes, Myriophyllum aquaticum, Schinus terebinthifolius, Urochloa mutica, Sphagneticola trilobata, Colocasia esculenta, Sapium sebiferum, Melaleuca quinquenervia* and *Ludwigia peruviana*) are non-native and invasive to this region. The vegetation community along Lake LeClare is dominated by a variety of emergent species including *Panicum repens, Acer rubrum, Taxodium, Melaleuca quinquenervia and Schinus terebinthifolius.* The water's surface in Lake LeClare was dominated by *Nuphar*. A total of 3 species of submerged aquatic vegetation were observed, *Utricularia gibba, Chara and Najas guadalupensis* with *Najas* being the dominant species. Submerged vegetation was limited in the lake due to the low water visibility and tanins blocking available light. By analyzing the collected sonar chart, submerged aquatic vegetation potentially covered approximately 15.1% of the surface area of Lake LeClare. This submerged vegetation inhabits an estimated 0.45% of the water volume in Lake LeClare. Figure 5 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 LeClare was 48, above the impairment threshold of 43 indicating that the vegetation community is "Healthy". Figure 6 shows the map of Lake LeClare 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.

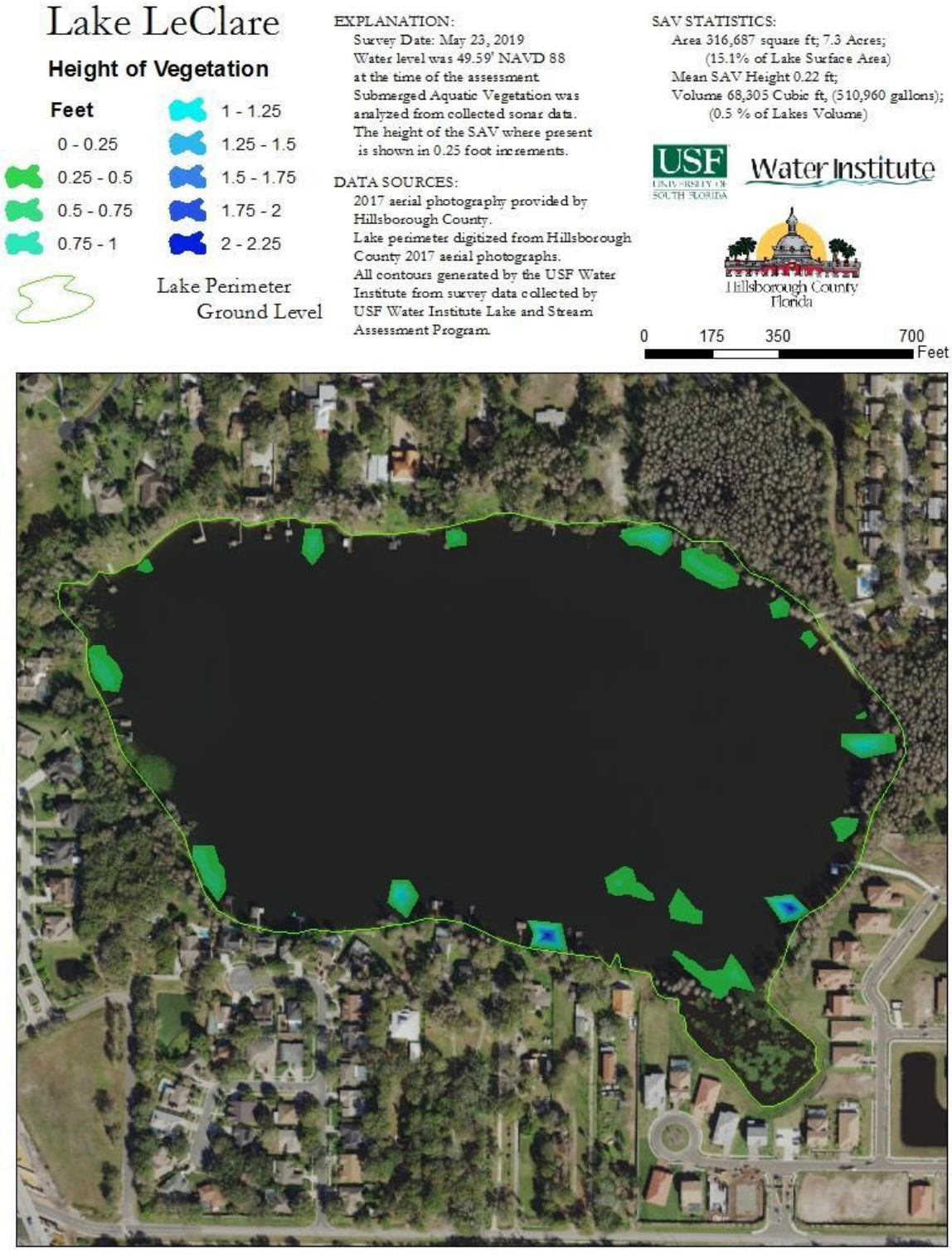


Figure 5 Lake LeClare Submerged Aquatic Vegetation Assessment Results

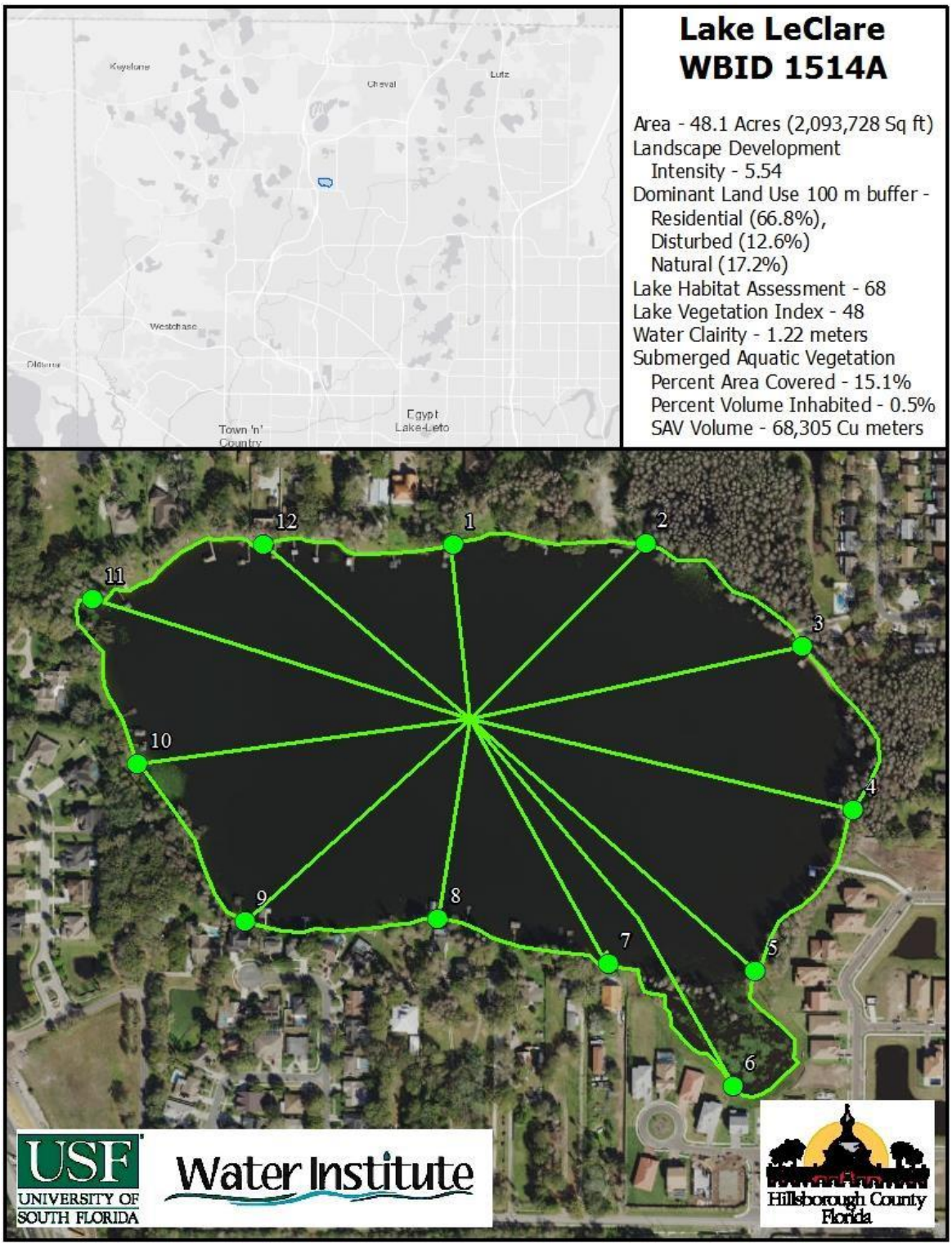


Figure 6: Lake Vegetation Index region map for Lake LeClare

Table 2: Lake Vegetation Index results for Lake LeClare May 23, 2019 (continued on following page)

SPECIES	CofC	3	6	9	12
Alternanthera philoxeroides	0.00	**1**	**1**	**1**	**1**
Blechnum serrulatum	5.50	**1**	**1**	**1**	**1**
Boehmeria cylindrica	5.00	**1**	**1**	**1**	**1**
Chara	3.90	**1**	**1**	**1**	**1**
Ludwigia peruviana	0.00	**1**	**1**	**1**	**1**
Melaleuca quinquenervia	0.00	**1**	**1**	**1**	**1**
Mikania scandens	1.95	**1**	**1**	**1**	**1**
Najas guadalupensis	5.07	**C**	**1**	**C**	**C**
Nuphar	3.50	**1**	**D**	**C**	**C**
Panicum repens	0.00	**1**	**1**	**1**	**1**
Taxodium	7.00	**1**	**1**	**1**	**1**
Acer rubrum	4.65	**1**	**1**		**1**
Bacopa monnieri	3.50	**1**	**1**		**1**
Eleocharis interstincta	7.80	**1**	**1**	**1**	
Hydrocotyle	2.00	**1**	**1**	**1**	
Panicum hemitomon	5.82	**1**		**1**	**1**
Ptilimnium capillaceum	2.73	**1**	**1**		**1**
Sagittaria lancifolia	3.00	**1**	**1**	**1**	
Cephalanthus occidentalis	5.00	**1**		**1**	
Colocasia esculenta	0.00	**1**		**1**	
Cyperus odoratus	3.00		**1**		**1**
Eupatorium capillifolium	0.83	**1**	**1**		
Fuirena scirpoidea	5.50	**1**			**1**
Juncus effusus	2.00	**1**	**1**		
Ludwigia octovalvis	2.00	**1**	**1**		
Myrica cerifera	2.00	**1**		**1**	
Persea palustris	7.00	**1**		**1**	
Pontederia cordata	5.38	**1**	**1**		
Salix caroliniana	2.95	**1**	**1**		
Sapium sebiferum	0.00	**1**		**1**	
Sphagneticola trilobata	0.00			**1**	**1**
Typha	1.00	**1**	**1**		
Utricularia gibba	6.37	**C**	**1**		
Canna flaccida	5.50		**1**		
Crinum americanum	9.00				**1**
Cyperus polystachyos	1.56				**1**

SPECIES	CofC	3	6	9	12
Echinochloa walteri	2.50		**1**		
Eichhornia crassipes	0.00		**1**		
Fuirena breviseta	3.50				**1**
Juncus marginatus	1.50				**1**
Myriophyllum aquaticum	0.98				**1**
Osmunda regalis	7.60		**1**		
Polygonum hydropiperoides	2.50			**1**	
Schinus terebinthifolius	0.00	**1**			
Schoenoplectus californicus	5.00		**1**		
Schoenoplectus tabernaemontani	5.55		**1**		
Sesbania herbacea	1.00		**1**		
Smilax		**1**			
Urochloa mutica	0.00			**1**	

Table 3: Scoring Summary for the Lake Vegetation Index

LVI Score Summary	Region			
	3	6	9	12
Total # of taxa in sampling unit	33	32	23	23
% Native taxa in sampling unit	78.79	84.38	65.22	73.91
% FLEPPC CAT 1 taxa in sampling unit	18.18	12.50	26.09	13.04
% Sensitive taxa in sample unit	9.09	9.38	13.04	8.70
Dominant CoC in sample unit	5.72	3.50	4.29	4.29
Native Score ((x-62.5)/37.5) or ((x-66.67)/25.89)=	0.468	0.684	0.000	0.280
Invasive FLEPPC 1 Score (1 - (x/30))=	0.394	0.583	0.130	0.565
Sensitive Score (x/(27.78 or 20)) =	0.455	0.469	0.652	0.435
Dominant CoC Score (x/(7.91 or 7)) =	0.817	0.500	0.612	0.612
Raw Score Total = N+I+S+D =	2.134	2.236	1.395	1.892
Division Factor = (3 D=0 or 4) =	4	4	4	4
Average LVI dividend = Raw /DF	0.533	0.559	0.349	0.473
South				
LVI Score for sampling unit =	53	56	35	47
Total LVI SCORE =	48			

Water Quality Assessment

Limited long-term water quality data is available for Lake LeClare. The available data was collected by USGS, FDEP, Hillsborough County and University of Florida LAKEWATCH program (1982-2019), however this dataset is incomplete with recent years having sparse data. There were no samples available for 2017 and only a single sample available for 2018. 2019 has monthly data available through August. Table 4 provides a summary of the Physical/Chemical conditions recorded at the middle of the Lake LeClare.

Table 4: Lake LeClare Water Quality (Field)

Depth (m)	Temp °C	pH	DO (mg/L)	DO (%sat)	Cond (unho/cm)	Salinity (ppt)	Secchi Depth (m)
0.19	31.16	9.73	8.66	115.6	145.3	0.07	1.22
1.11	30.9	9.48	8.47	112.5	145	0.07	
2.17	30.18	8.31	4.43	58.1	144.7	0.07	
POR	24.39	6.81	7.7		143.8	0.06	1.67

The chemical water quality analysis for Lake LeClare is shown in Table 5 for the sample taken on May 29, 2019. 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 0.05 mg/l with a value of 0.021 mg/l for the POR and below the threshold for the most recent 3 years of samples with a value of 0.020 mg/l. If sampling were to be sufficient (previous three years of quarterly sampling) the threshold could be as high as 0.16 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 0.723 mg/l for the POR data. The Total Nitrogen value for the most recent 3 years of data was 0.674 mg/l (0.650 mg/l for 2019 samples). If sampling were to be sufficient (previous three years of quarterly sampling) the threshold could be as high as 2.23 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 11.6 µg/l. The UF LAKEWATCH data is for uncorrected chlorophyll-a and has a mean value for the period of record of 8.97 µg/l.

Bacteria testing showed low levels of E. Coli (4 colonies/100ml) and Enterococci (8 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 LeClare Water Quality Results from 5/23/19 (Laboratory)

Parameter	Lake LeClare (Center)	POR Mean Value	Units
Alkalinity	32.0		mg/LCaCO3
E Coli	4		#/100ml
Nitrates/Nitrites	0.018	0.057	mg/L
Enterococci	8		#/100 ml
Chlorophyll a	12.9	8.97	ug/L
Chlorophyll b	0.4		ug/L
Chlorophyll c	0.7		ug/L
Chlorophyll t	14.0		ug/L
Chlorophylla Corr	11.6		ug/L
Chlorophyll-pheo	1.5		ug/L
Ammonia	0.005	0.052	mg/L
Kjeldahl Nitrogen	0.628	0.685	mg/L
Total Nitrogen	0.628	0.723	mg/L
Total Phosphorus	0.012	0.021	mg/L
Color(345)F.45	20.4	29.5	Pt/Co

Table 6: Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	29.5
Number of Samples	3
Geometric Mean Alkalinity (mg/L $CACO_3$)	32.0
Number of Samples	1
Lake Type	Colored
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 Corrected ug/L	11.6
Geomean TP mg/L	0.020
Geomean TN mg/L	0.674
Number of Samples	9
Potential Impaired Chlorophyll a	Not Impaired
Potential Impaired TP	Not Impaired
Potential Impaired TN	Not Impaired

Conclusion

The results of the assessment of Lake LeClare shows a healthy lake based on Total Nitrogen and Total Phosphorous 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 with a minimum of three samples per year for the previous three years. The most recent year of data for Total Phosphorous is below the nutrient threshold. The system also shows health in the vegetation communities according to the Lake Vegetation Index with high overall species (49), moderate occurrences of non-native, invasive species and few sensitive plant species with an overall LVI score of 48. The assessment also revealed some submerged aquatic vegetation community comprising 3 species occupying 15.13% of the surface area and 0.5% of the volume of Lake LeClare.