

Lake Frances

Methods

Study Area Analysis

The watershed containing Lake Frances 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 zero. In the Florida framework, the maximum LDI index score is approximately 42."

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 Frances is located in the Lake Frances Preserve north-western Hillsborough County near Keystone, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Lake Frances is dominated by Natural Land (65.1%), Low Intensity Pasture (30.9%) and Single Family Residential (4.01%) land uses. The resulting LDI value for the 100 meter buffer around Lake Frances is 7.4.

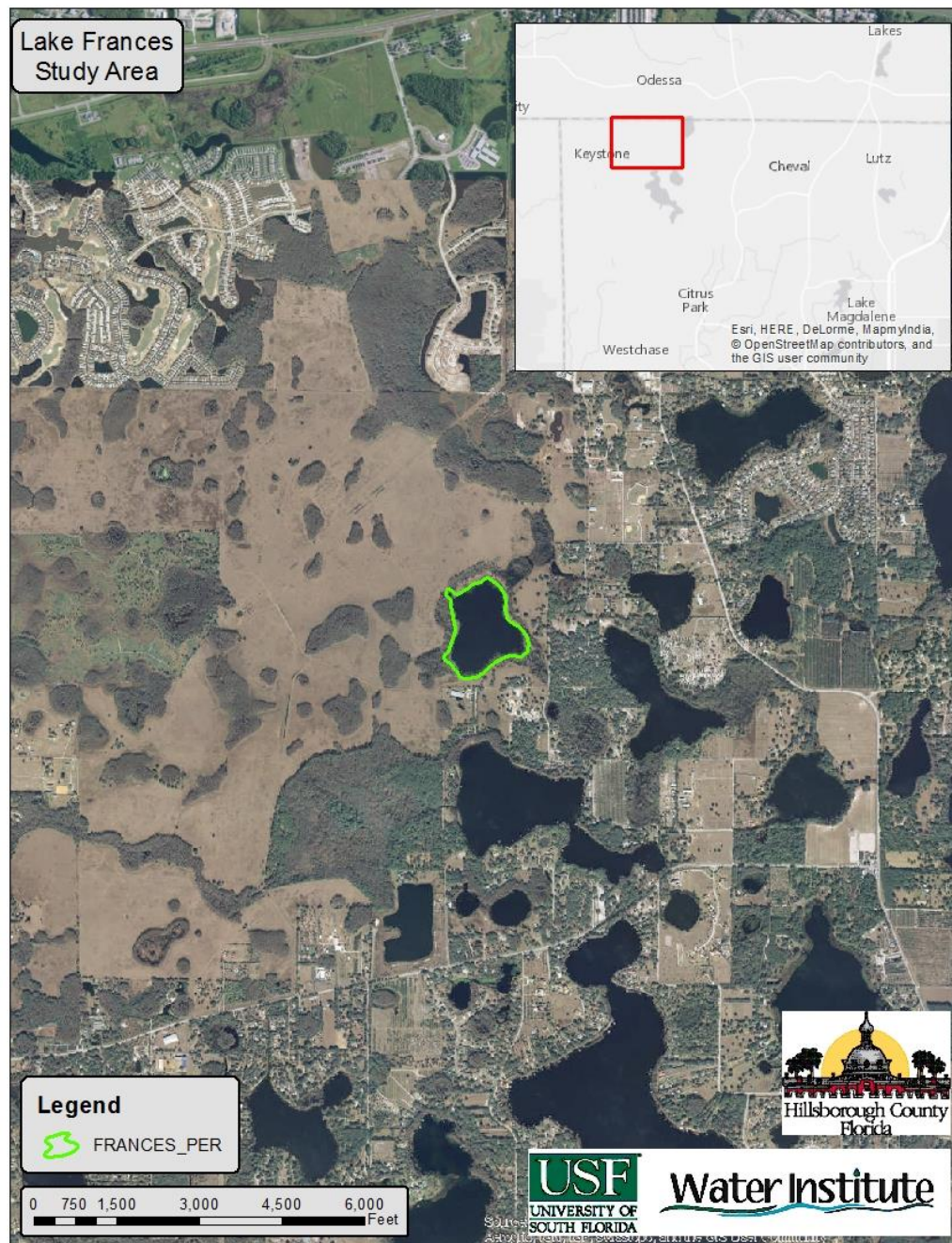


Figure 1 2015 Lake Frances Assessment Study Area Map

Lake Bathymetry and Morphological Characterization

Lake Frances is a depression system connected to the surrounding wetlands. At the time of the assessment, Lake Frances was experiencing moderately high water levels resulting in a 39.65 acre water body. Lake Frances at the time of the assessment had a mean water depth of 9.44 feet and a maximum observed depth of 17.0 feet. The volume at this time was approximately 121,979,734 gallons. Figure 2 shows the resulting bathymetric contour map for Lake Frances from data collected on August 17, 2015. The collected data has been overlain the 2011 Hillsborough County aerals.

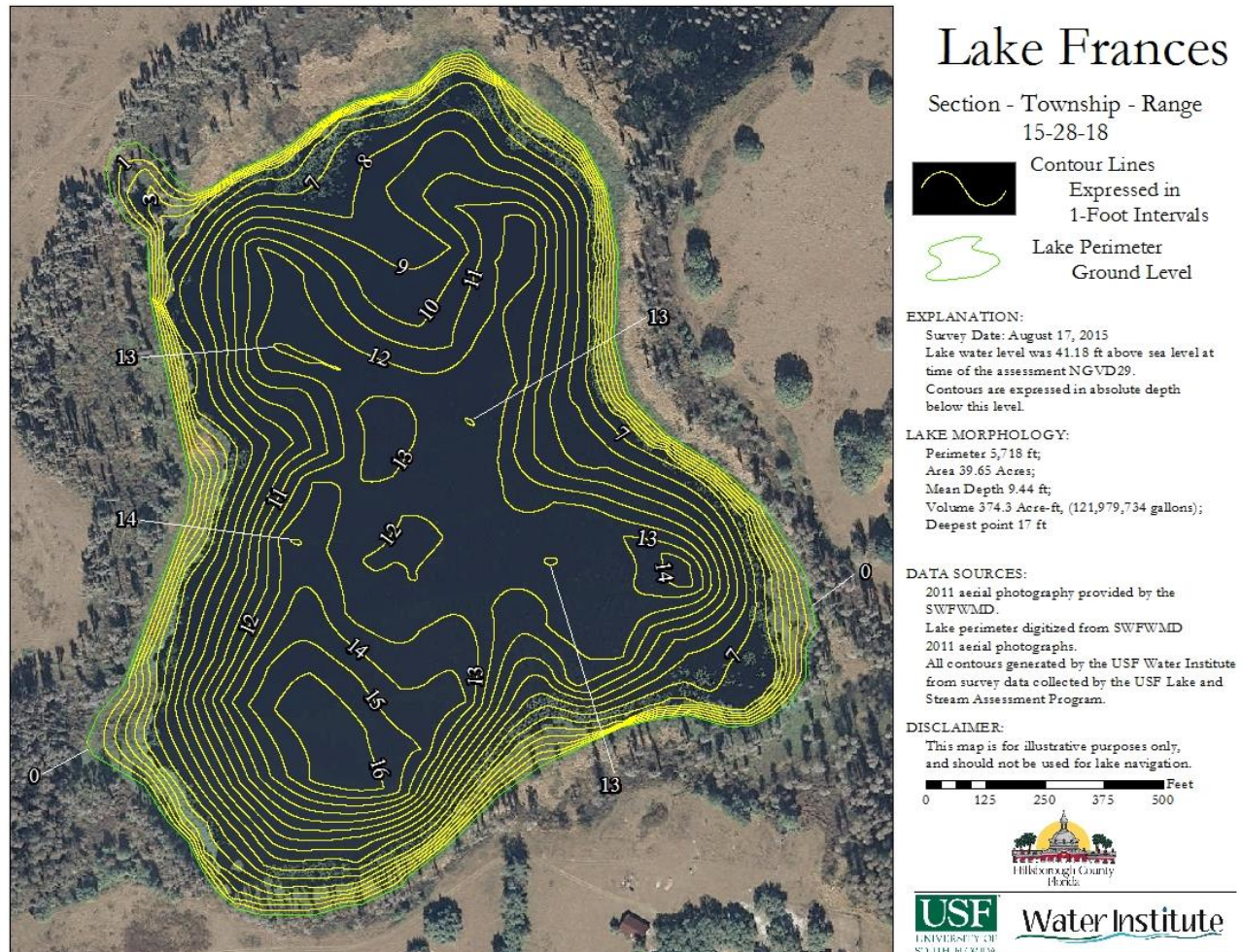


Figure 2 2015 1-Foot Bathymetric Contour Map for Lake Frances

Table 1 Morphological Calculations for Lake Frances

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	1,717,240	159,537	39.65	0	0
Mean Depth	9.44	2.88	0	0	0
Maximum Depth	17.0	5.18	0	0	0
Volume (cubic)	16,306,206	461,740	0	374.3	121,979,734
Gauge (relative)	41.18	12.55	0	0	0

Lake Vegetation Index Assessment



Figure 3 Overview photograph of Lake Frances

The lake assessment for Lake Frances was conducted on August 17, 2015. Lake Frances received a lake habitat assessment (FEDP form FD 9000-6) score of 104 due to optimal scores for Lakeside Adverse Human Alteration, Upland Buffer Zone, Stormwater Inputs and Adverse Watershed Land Use. Suboptimal scores were noted for Vegetation Quality. Marginal scores were achieved for Secchi and Bottom Substrate Quality.



Figure 4 At the time of the assessment, Lake Frances was dominated by a rim of *Ludwigia peruviana*, a non-native invasive species resulting in a lower LVI score.

The Lake Vegetation Index identified 17 species of wetland vegetation growing in the four selected sections along Lake Frances. The majority of these species (12) are native species. The remaining 5 species (*Panicum repens*, *Alternanthera philoxeroides*, *Salvinia minima*, *Oxycaryum cubense* and *Ludwigia peruviana*) are non-native and invasive to this region. Two sensitive taxa were identified on Lake Frances; *Taxodium* and *Gordonia lasianthus*. The vegetation community along Lake Frances is dominated by a variety of emergent species including *Ludwigia peruviana* (Figure 4), *Taxodium* and *Ilex cassine* (Figure 5). The water's surface in Lake Frances was dominated by *Salvinia minima* (Figure 6). The calculated LVI score for Lake Frances was 33, below the impairment threshold of 37. Figure 7 shows the map of Lake Frances 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 was not observed during the assessment however by analyzing the collected sonar chart, submerged aquatic vegetation covered approximately 5% of the surface area of Lake Frances. This submerged vegetation inhabits an estimated 0.84% of the water volume in Lake Frances.



Figure 5 The emergent vegetation community in areas where *Ludwigia peruviana* was absent was occupied by a variety of native species



Figure 6 *Salvinia minima* on Lake Frances

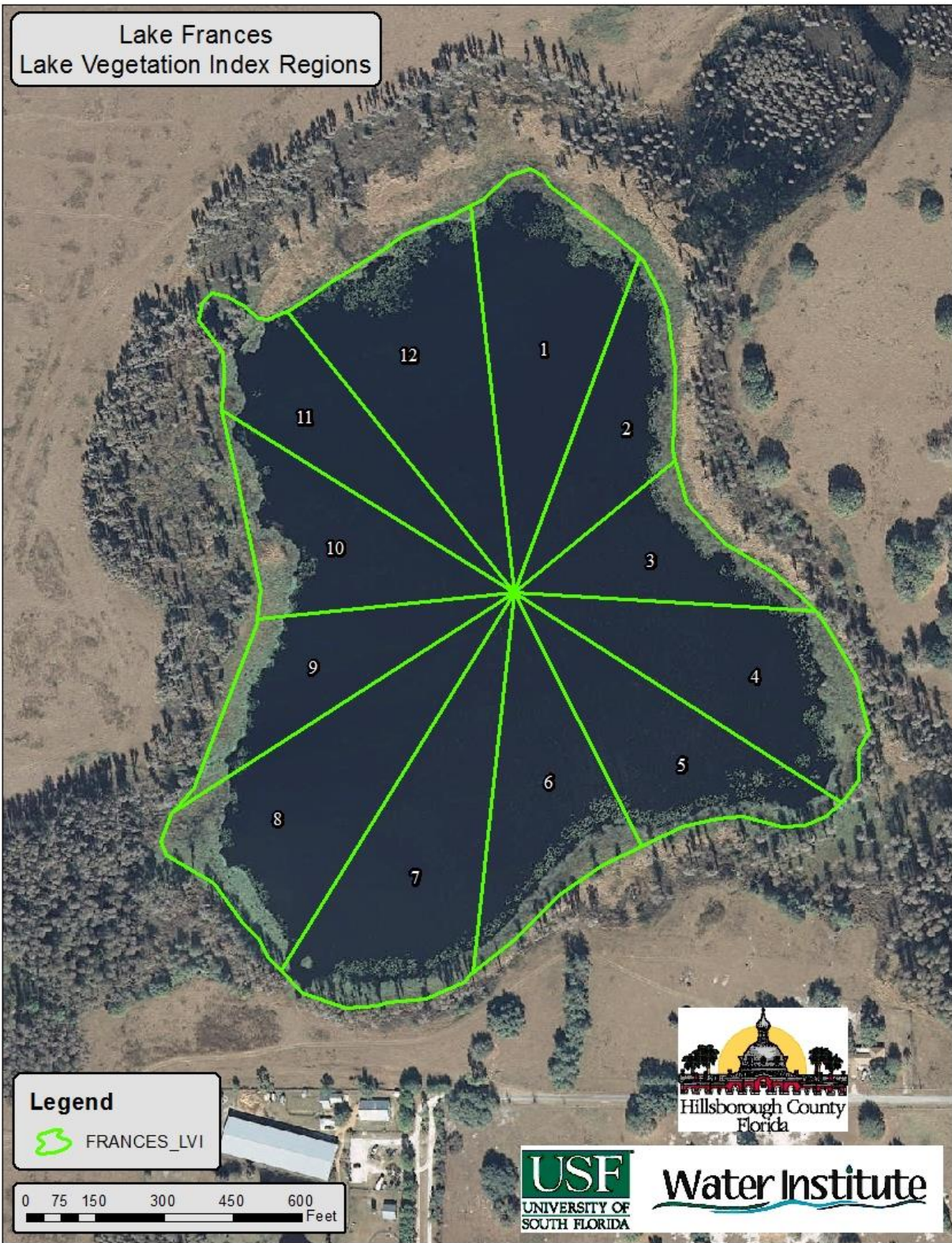


Figure 7 Lake Vegetation Index region map for Lake Frances

Table 2 Lake Vegetation Index results for Lake Frances on 8/17/15

SPECIES	Region				
	CofC	3	6	9	12
<i>Alternanthera philoxeroides</i>	0.00	1	1	1	1
<i>Ludwigia peruviana</i>	0.00	D	D	D	D
<i>Myrica cerifera</i>	2.00	1	1	1	1
<i>Nuphar</i>	3.50	1	1	1	1
<i>Pontederia cordata</i>	5.38	1	1	1	1
<i>Salvinia minima</i>	0.00	1	1	1	1
<i>Taxodium</i>	7.00	1	1	1	1
<i>Gordonia lasianthus</i>	7.00	1		1	1
<i>Hydrocotyle</i>	2.00		1	1	1
<i>Ilex cassine</i>	6.00	1		1	1
<i>Typha</i>	1.00	1	1		1
<i>Acer rubrum</i>	4.65			1	
<i>Blechnum serrulatum</i>	5.50			1	
<i>Cephalanthus occidentalis</i>	5.00		1		
<i>Juncus effusus</i>	2.00		1		
<i>Oxycaryum cubense</i>	0.50		1		
<i>Panicum repens</i>	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	10	13	12	11
% Native taxa in sampling unit	70	61.538/46	75	72.7272
% FLEPPC CAT 1 taxa in sampling unit	20	23.07692	16.6667	18.1818
% Sensitive taxa in sample unit	20	7.69308	16.6667	18.1818
Dominant CoC in sample unit	0	0	0	0
Native Score $((x-62.5)/37.5)$ or $((x-66.67)/25.89)=$	0.128621	0	0.321746	0.233962
Invasive FLEPPC 1 Score $(1 - (x/30))=$	0.333333	0.230769	0.444444	0.393939
Sensitive Score $(x/(27.78 \text{ or } 20)) =$	1	0.384615	0.833333	0.909091
Dominant CoC Score $(x/(7.91 \text{ or } 7)) =$	0	0	0	0
Raw Score Total = $N+I+S+D =$	1.461954	0.615385	1.599524	1.536992
Division Factor = $(3 \text{ D}=0 \text{ or } 4) =$	4	4	4	4
Average LVI dividend = Raw / DF	0.365489	0.153846	0.399881	0.384248
South				
LVI Score for sampling unit =	36.54886	15.38462	39.98809	38.4248
Total LVI SCORE =	33			

Water Quality Assessment

Long-term water quality data is available for Lake Frances from the University of Florida LakeWatch program taken by Hillsborough County Parks Staff. The available data was added to the data collected as part of this lake assessment. Table 4 provides a summary of the physical water quality conditions recorded at the middle of Lake Frances.

Table 4 Lake Frances Water Quality (Field)

Depth (m)	Temp (C)	pH	DO (mg/L)	DO (% Sat)	Cond (umho/cm)	Salinity (ppt)	TDS (mg/L)	Secchi Depth (m)
0.16	29.51	5.09	5.21	67.6	0.026	0.02	16.9	0.84
0.42	29.52	5.25	5.09	66	0.026	0.02	16.8	
2.16	26.83	4.99	0	0	0.03	0.02	19.8	
2.16	26.83	5.15	0	0	0.031	0.02	19.9	
2.43	26.24	5.13	0	0	0.032	0.02	20.8	
3.52	25.11	5.25	0	0	0.037	0.02	23.9	

The chemical water quality analysis for Lake Frances is shown in Table 5 for the sample taken on August 17, 2015. Table 6 includes this data in the numeric nutrient criteria framework using the geometric mean values for the past three years for available parameters. Chlorophyll –a uncorrected values were used for the analysis of Chlorophyll NNC since the LakeWatch program does not analyze Chlorophyll-a corrected for pheophytin. Total Phosphorous values were below the nutrient threshold for dark lakes with sufficient data developed by FDEP of 0.16 mg/l with a value of 0.039 mg/l. Total Nitrogen values were below the nutrient threshold for dark lakes with sufficient data developed by FDEP of 2.23 mg/l with a value of 0.782 mg/l. Chlorophyll-a values are below the nutrient threshold for dark lakes developed by FDEP of 20.0 µg/l with a value of 16.2 µg/l.

Bacteria testing showed low levels of Fecal Coliform (10 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 Frances Water Quality Results from 8/17/2015(Laboratory)

Parameter	Value	Units
Alkalinity	6	mg/LCaCO3
Nitrates/Nitrites	0.003	mg/L
Fecal Coliform	10	#/100 ml
Enterococci	950	#/100 ml
Chlorophyll a	60.8	ug/L
Chlorophyll b	5.9	ug/L
Chlorophyll c	4.2	ug/L
Chlorophyll t	70.9	ug/L
Chlorophylla Corr	49.6	ug/L
Chlorophyll-pheo	16.2	ug/L
Ammonia	0.014	mg/L
Kjeldahl Nitrogen	0.586	mg/L
Total Nitrogen	0.589	mg/L
Total Phosphorus	0.038	mg/L
Color(345)F.45	51.9	Pt/Co

Table 6 Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	51.9
Number of Samples	1
Geometric Mean Alkalinity (mg/L CaCO ₃)	6
Number of Samples	1
Lake Type	Dark
Chlorophyll a Criteria (ug/L)	20
Sufficient for Geomean Criteria then P mg/L	0.16
Sufficient for Geomean Criteria then N mg/L	2.23
Geomean Chla ug/L	16.2
Geomean TP mg/L	0.039
Geomean TN mg/L	0.782
Number of Samples	39
Potential Impaired Chlorophyll a	Not Impaired
Potential Impaired TP	Not Impaired
Potential Impaired TN	Not Impaired

Conclusion

The results of the assessment of Lake Frances does not show impairment based on Total Nitrogen, Total Phosphorous and Chlorophyll concentrations according to the FDEP numeric nutrient criteria using the available data. The system does shows impairment in the vegetation communities according to the Lake Vegetation Index with low overall species and dominance by a non-native, invasive species with an overall LVI score of 33. Bacteria sampling showed low levels of Fecal Coliform bacteria present at the time of the assessment.