

# Little Halfmoon Lake

---

## Methods

### Study Area Analysis

The watershed containing Little Halfmoon Lake 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**<sup>i</sup> 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)<sup>ii</sup> 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.

---

<sup>i</sup> 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.

<sup>ii</sup> 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  $\geq 7$  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

Little Halfmoon Lake is located northeast of Citrus Park, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Little Halfmoon Lake is dominated by Low Density Single Family Residential (58.93%), Medium Density Single Family Residential (24.25%) and Natural Land (15.74%) land uses. The resulting LDI value for the 100 meter buffer around Little Halfmoont Lake is 21.79.

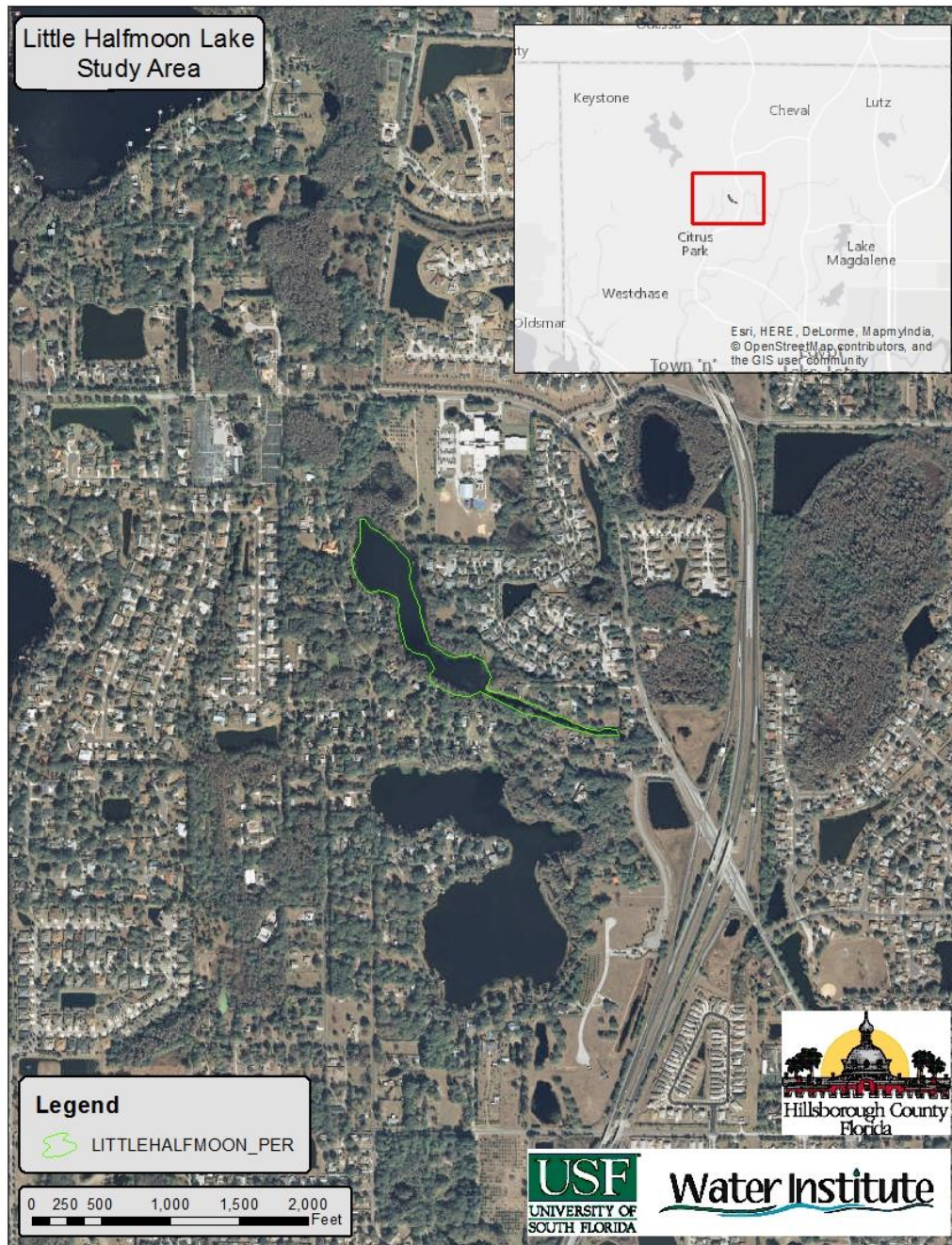


Figure 1 2015 Little Halfmoon Lake Assessment Study Area Map



## Lake Bathymetry and Morphological Characterization

Little Halfmoon Lake is an elongated, deep system. At the time of the assessment, Little Halfmoon Lake was experiencing moderately high water levels resulting in a 10.36 acre water body. Little Halfmoon Lake at the time of the assessment had a mean water depth of 7.44 feet and a maximum observed depth of 18.99 feet. The volume at this time was approximately 25,133,888 gallons. Figure 2 shows the resulting bathymetric contour map for Little Halfmoon Lake from data collected on August 13, 2015. The collected data has been overlain the 2011 Hillsborough County aerials.



Figure 2 2015 1-Foot Bathymetric Contour Map for Little Halfmoon Lake

**Table 1 Morphological Calculations for Little Halfmoon Lake**

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	451,476	41,943	10.36	0	0
Mean Depth	7.44	2.27	0	0	0
Maximum Depth	18.99	5.79	0	0	0
Volume (cubic)	3,359,888	95,141	0	77.13	25,133,888
Gauge (relative)	37.34	11.38	0	0	0

## Lake Vegetation Index Assessment



**Figure 3 Overview photograph of Little Halfmoon Lake**

The lake assessment for Little Halfmoon Lake was conducted on August 13, 2015. Little Halfmoon Lake received a lake habitat assessment (FEDP form FD 9000-6) score of 81 due to Optimal scores for Stormwater Inputs and suboptimal scores for Secchi, Vegetation Quality and Upland Buffer Zone. Marginal scores were achieved for Bottom Substrate Quality, Lakeside Adverse Human Alterations, and Adverse Watershed Land Use.





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

The Lake Vegetation Index identified 37 species of wetland vegetation growing in the four selected sections along Little Halfmoon Lake. The majority of these species (25) are native species. The remaining 12 species (*Panicum repens*, *Alternanthera philoxeroides*, *Sapium sebiferum*, *Sphagneticola trilobata*, *Ruellia simplex*, *Melaleuca quinquemervia*, *Schinus terebinthifolius*, *Colocassia esculenta*, *Oxycaryum cubense*, *Salvinia minima*, *Urochloa mutica* and *Ludwigia peruviana*) are non-native and invasive to this region. The vegetation community along Little Halfmoon Lake is dominated by a variety of emergent species including *Ludwigia peruviana*, *Taxodium* and *Blechnum serrulatum* (Figure 5). The water's surface in Little Halfmoon Lake was dominated by *Nuphar* (Figure 6). The calculated LVI score for Little Halfmoon Lake was 28, below the impairment threshold of 37. Figure 7 shows the map of Little Halfmoon Lake 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 observed during the assessment included *Potamogeton diversifolius*. By analyzing the collected sonar chart, submerged aquatic vegetation covered approximately 26% of the surface area of Little Halfmoon Lake. This submerged vegetation inhabits an estimated 4.38% of the water volume in Little Halfmoon Lake.





Figure 5 *Ludwigia peruviana* on Little Halfmoon Lake



Figure 6 *Nuphar* on Little Halfmoon Lake



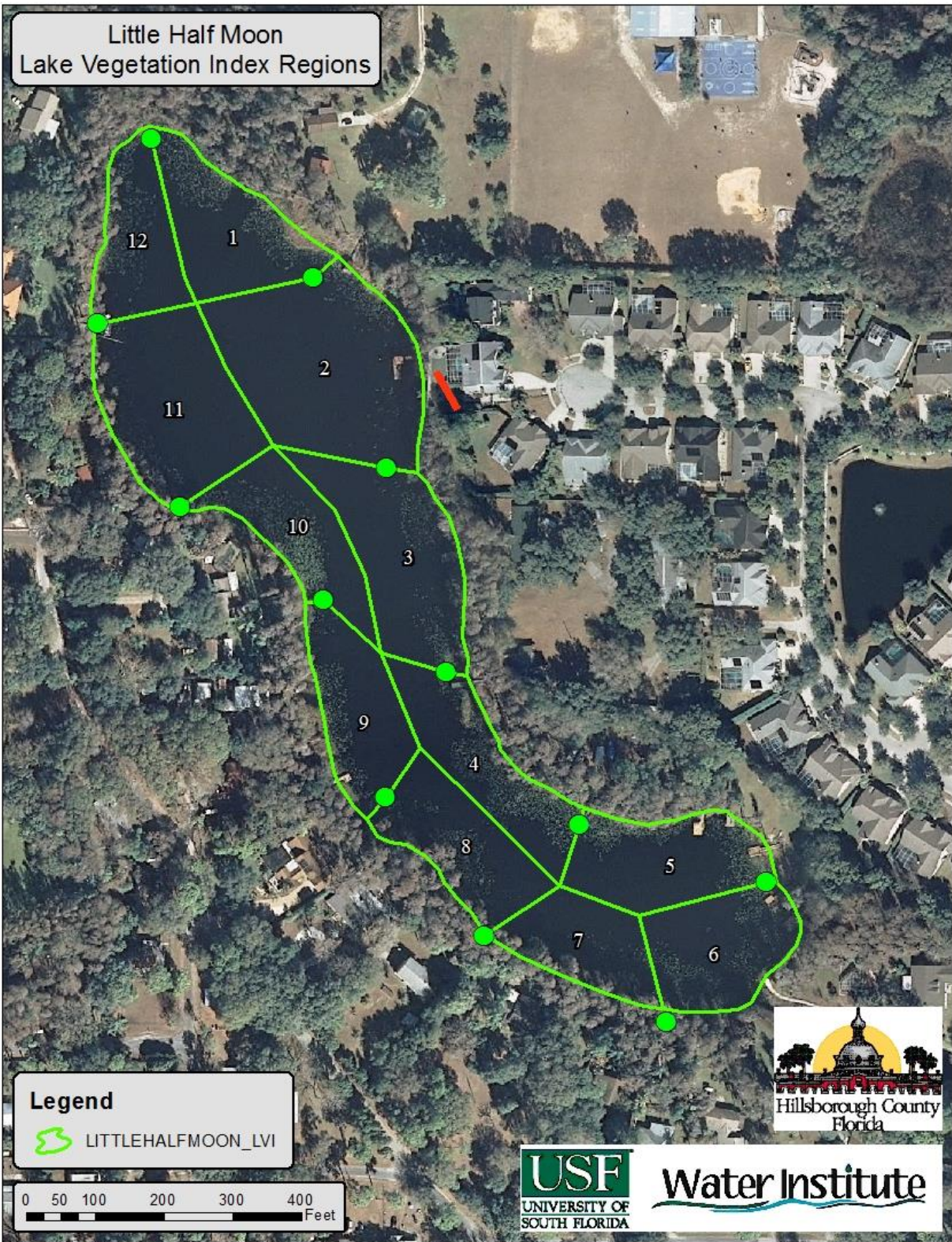


Figure 7 Lake Vegetation Index region map for Little Halfmoon Lake

Table 2 Lake Vegetation Index results for Little Halfmoon Lake 8/13/2015

SPECIES	Region				
	CofC	2	5	8	11
<i>Alternanthera philoxeroides</i>	0.00	1	1	1	1
<i>Blechnum serrulatum</i>	5.50	1	1	1	1
<i>Ludwigia peruviana</i>	0.00	1	1	1	1
<i>Nuphar</i>	3.50	C	D	D	D
<i>Panicum repens</i>	0.00	1	1	1	1
<i>Salvinia minima</i>	0.00	1	1	1	1
<i>Taxodium</i>	7.00	C	1	1	1
<i>Vitis rotundifolia</i>	1.18	1	1	1	1
<i>Cephalanthus occidentalis</i>	5.00	1	1		1
<i>Hydrocotyle</i>	2.00		1	1	1
<i>Oxycaryum cubense</i>	0.50	1		1	1
<i>Panicum hemitomon</i>	5.82	1		1	1
<i>Acer rubrum</i>	4.65		1	1	
<i>Melaleuca quinquenervia</i>	0.00		1		1
<i>Mikania scandens</i>	1.95	1	1		
<i>Myrica cerifera</i>	2.00	1	1		
<i>Sapium sebiferum</i>	0.00	1		1	
<i>Schinus terebinthifolius</i>	0.00	1	1		
<i>Typha</i>	1.00	1	1		
<i>Urochloa mutica</i>	0.00	1			1
<i>Andropogon</i>		1			
<i>Boehmeria cylindrica</i>	5.00		1		
<i>Canna flaccida</i>	5.50	1			
<i>Colocasia esculenta</i>	0.00			1	
<i>Eclipta prostrata</i>	2.00	1			
<i>Ludwigia leptocarpa</i>	3.00				1
<i>Magnolia virginiana</i>	7.00		1		
<i>Paspalidium geminatum</i>	5.50		1		
<i>Persea palustris</i>	7.00		1		
<i>Polygonum hydropiperoides</i>	2.50				1
<i>Pontederia cordata</i>	5.38		1		
<i>Potamogeton diversifolius</i>	6.00		1		
<i>Quercus laurifolia</i>	4.00		1		
<i>Ruellia simplex</i>	0.00	1			
<i>Salix caroliniana</i>	2.95		1		
<i>Sphagneticola trilobata</i>	0.00				1
<i>Utricularia gibba</i>	6.37	1			



Table 3 Scoring Summary for the Lake Vegetation Index

LVI Score Summary	Region			
	2	5	8	11
Total # of taxa in sampling unit	22	24	14	17
% Native taxa in sampling unit	59.09091	75	50	52.94118
% FLEPPC CAT 1 taxa in sampling unit	31.81818	20.83333	35.71429	29.41176
% Sensitive taxa in sample unit	4.545455	12.5	7.142857	5.882353
Dominant CoC in sample unit	5.25	3.5	3.5	3.5
Native Score $((x-62.5)/37.5)$ or $((x-66.67)/25.89)=$	0	0.321746	0	0
Invasive FLEPPC 1 Score $(1 - (x/30))=$	0	0.305556	0	0.019608
Sensitive Score $(x/(27.78 \text{ or } 20)) =$	0.227273	0.625	0.357143	0.294118
Dominant CoC Score $(x/(7.91 \text{ or } 7)) =$	0.75	0.5	0.5	0.5
Raw Score Total = $N+I+S+D =$	0.977273	1.752301	0.857143	0.813725
Division Factor = $(3 \text{ D}=0 \text{ or } 4) =$	4	4	4	4
Average LVI dividend = Raw /DF	0.244318	0.438075	0.214286	0.203431
South				
LVI Score for sampling unit =	24.43182	43.80754	21.42857	20.34314
Total LVI SCORE =	28			

## Water Quality Assessment

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

Table 4 Little Halfmoon Lake Water Quality (Field)

Depth (m)	Temp (C)	pH	DO (mg/L)	DO (% Sat)	Cond (umho/cm)	Salinity (ppt)	TDS (mg/L)	Secchi Depth (m)
0.11	30.24	6.73	4.26	56	129	0.06	82.5	1.54
0.27	30.16	6.58	3.65	47.9	128.6	0.06	82.3	
2.36	26.55	6.21	0.25	3.1	124.1	0.06	79.4	
4.71	23.78	6.16	0.64	7.5	176.8	0.08	113.2	

The chemical water quality analysis for Little Halfmoon Lake is shown in Table 5 for the sample taken on August 13, 2015. 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 clear alkaline lakes with insufficient data developed by FDEP of 0.03 mg/l with a value of 0.053 mg/l. Total Nitrogen values were below the nutrient threshold for clear alkaline lakes with insufficient data developed by FDEP of 1.05 mg/l with a value of 0.568 mg/l. Chlorophyll-a values are above the nutrient threshold for clear alkaline lakes developed by FDEP of 20.0 µg/l with a value of 34.7 µg/l.

Bacteria testing showed low levels of Fecal Coliform ( < 10 colonies/100ml) above 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 Little Halfmoon Lake Water Quality Results from 8/13/2015(Laboratory)

Parameter	Value	Units
Alkalinity	36.0	mg/LCaCO <sub>3</sub>
Nitrates/Nitrites	0.003	mg/L
Fecal Coliform	<10	#/100 ml
Enterococci	170	#/100 ml
Chlorophyll a	40.1	ug/L
Chlorophyll b	2.6	ug/L
Chlorophyll c	5.1	ug/L
Chlorophyll t	45.2	ug/L
Chlorophylla Corr	34.7	ug/L
Chlorophyll-pheo	6.7	ug/L
Ammonia	0.112	mg/L
Kjeldahl Nitrogen	0.565	mg/L
Total Nitrogen	0.568	mg/L
Total Phosphorus	0.053	mg/L
Color(345)F.45	32.7	Pt/Co

**Table 6 Numeric Nutrient Criteria Framework**

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	32.7
Number of Samples	1
Geometric Mean Alkalinity (mg/L CaCO <sub>3</sub> )	36.0
Number of Samples	1
Lake Type	Clear Alkaline
Chlorophyll a Criteria (ug/L)	20
Insufficient for Geomean Criteria then P mg/L	0.03
Insufficient for Geomean Criteria then N mg/L	1.05
Geomean Chla ug/L	34.7
Geomean TP mg/L	0.053
Geomean TN mg/L	0.568
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 Little Halfmoon Lake shows 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 also shows impairment in the vegetation communities according to the Lake Vegetation Index with moderate overall species, high occurrences of non-native, invasive species and two sensitive plant species with an overall LVI score of 28. Bacteria sampling also revealed a low biomass of Fecal Coliform bacteria present at the time of the assessment.