

Boot Lake

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

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Methods

STUDY AREA ANALYISIS

The watershed containing the Lake was analyzed using ESRI ArcGIS Pro. Using this software with 2023 ESRI Basemaps aerial, 2020 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 FDEP (https://floridadep.gov/dear/bioassessment/content/bioassessment-ldi-hdg-bcg). "The Landscape Development Intensity index (LDI) is an estimate of how much humans have altered an area of interest around a waterbody. Various land use types (low density residential, row crops, industrial, natural) are assigned coefficients of land use intensity based on estimates of the amount of human energy that is put into those land use types. 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. For streams and rivers, DEP typically uses a LDI calculated for the 100 m buffer of the waterbody for 10 km upstream of the point of interest. For lakes and isolated wetlands, DEP typically uses a LDI calculated for the 100 m buffer around the waterbody. 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 Hillsborough County Public Utilities Laboratory Analysis include; Chlorophyll (a, b, c, t and corrected), Alkalinity, Color, E Coli, 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. Due to the lack of public access to the majority of lakes in Hillsborough County, the majority of available water quality samples are from the resident volunteer LAKEWATCH program. This data is being included in the analysis of Hillsborough County lakes.

Study Area

Boot Lake is located in the Sweetwater Creek Watershed in central Hillsborough County, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Boot Lake is dominated by residential (93%) and natural (5%) land uses. The resulting LDI value for the 100 meter buffer around Boot Lake is 7.2.

FIGURE 1: 2025 BOOT LAKE ASSESSMENT STUDY AREA MAP



Lake Bathymetry and Morphological Characterization

At the time of the assessment, Boot Lake was experiencing normal water levels (33.76 feet NAVD88 on staff gauge) resulting in a 33.1 acre water body. Boot Lake at the time of the assessment had a mean water depth of 8.5 feet and a maximum observed depth of 16.4 feet. The volume at this time was approximately 91,264,537 gallons. Figure 2 shows the resulting bathymetric contour map for Boot Lake from data collected on July 10, 2025.

Table 1: Morphological Calculations for Boot Lake

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	1,441,084	133,880	33.1		
Mean Depth	8.5	2.58			
Maximum Depth	16.40	5.0			
Volume (cubic)	12,200,209	345,468		280.1	91,264,537
Gauge (NAVD 88)	33.76	10.29			

Figure 2: 2025 2-Foot Bathymetric Contour Map for Boot Lake

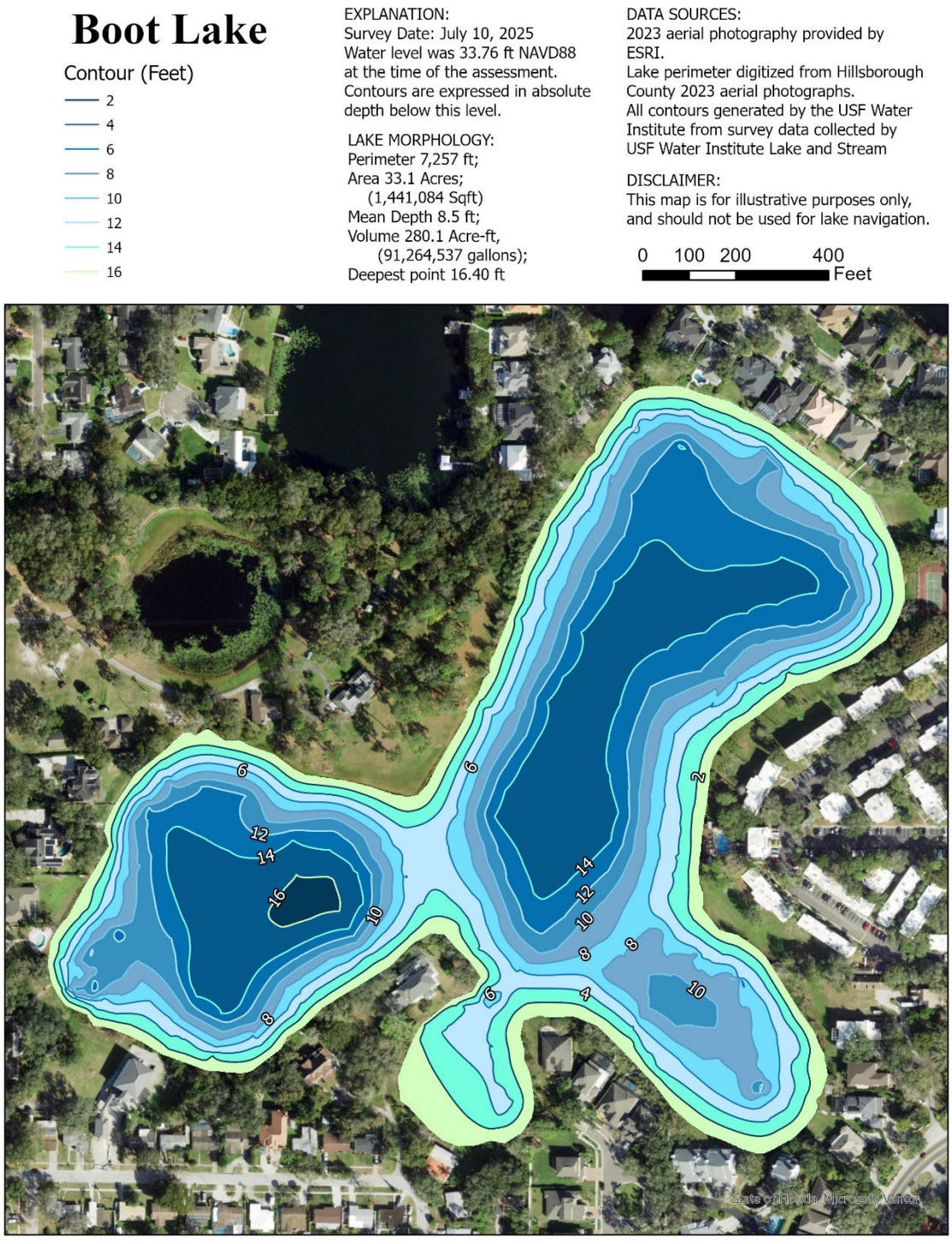



Figure 3 Overview photograph of Boot Lake showing the dominant floating leaved vegetation Nymphaea odorata.

Lake Habitat and Lake Vegetation Index Assessment

The lake assessment for Boot Lake was conducted on July 10, 2025. The water in Boot Lake was characterized as clear with low turbidity. The secchi disk depth was 1.68 meters (5.51 ft). The vegetation quality of the plants in and buffering Boot Lake are predominantly native species with extensive growths of *Nitella* and *Nymphaea odorata.* The percentage of non-native FLEPPC 1 species ranged from 3.57% (region 1) to 14.81% (region 7). Stormwater reaches the lake predominately via ditches, pipes, and surface flow over cultivated vegetation, and there are either ineffective or no BMPs in place. The bottom substrate quality was dominated by sandy material and submersed vegetation. The development along the shoreline has altered the surrounding buffer extensively with greater than 70% of the shoreline being residential houses with less than 18 meters of buffer.



Figure 4 The native submersed aquation macroalgae Nitella was dominant in regions 1 and 10 and was codominant in region 4 of the Lake Vegetation Index on Boot Lake

The Lake Vegetation Index identified 43 species of wetland vegetation growing in the four selected sections along Boot Lake. The majority of these species (35) are native species. The remaining 8 species (*shown in Table 2*) are non- native or invasive to this region. The vegetation community along the shorelines of Boot Lake has been altered by residential housing removing the buffer vegetation. The edges of the lake are dominated by species able to rapidly colonize following the frequent disturbance of mowing, such as *Panicum repens* and emergent aquatics such as T*ypha.* At the time of the assessment the water transparency was 1.68 m (5.51 ft). High annual average secchi disk depths allow for an extensive littoral zone with establishment of floating leaved and submerged aquatic vegetation. Six species of submersed aquatic vegetation were observed during the lake vegetation index, these species include *Najas guadalupensis, Nitella, Utricularia gibba, Utricularia inflata, Eleocharis* and *Vallisneria americana*. The floating leaved vegetation community had 3 species present, including *Nymphaea odorata, Nuphar and Hydrocotyle. Nymphaea odorata* was classified as dominant in region 7 and codominant in region 4 of the Lake Vegetation Index.

The calculated LVI score for Boot Lake was 61, above the impairment threshold of 43 indicating the vegetation community is showing evidence of being "Healthy". Figure 5 shows the map of Boot Lake detailing the LVI regions used for the assessment (Regions 1, 4, 7, 10). Table 2 details the species list results of the Lake Vegetation Index. Table 3 details the scoring result for the Lake Vegetation Index.

By analyzing the collected sonar chart, submerged aquatic vegetation potentially covered approximately 43.2% of the surface area of Boot Lake. This submerged vegetation inhabits an estimated 3.33% of the water volume in Boot Lake. The average height of submersed aquatic vegetation was 0.7 ft. Figure 6 shows the results of the SAV analysis indicating the location and height of SAV estimated from collected sonar readings.

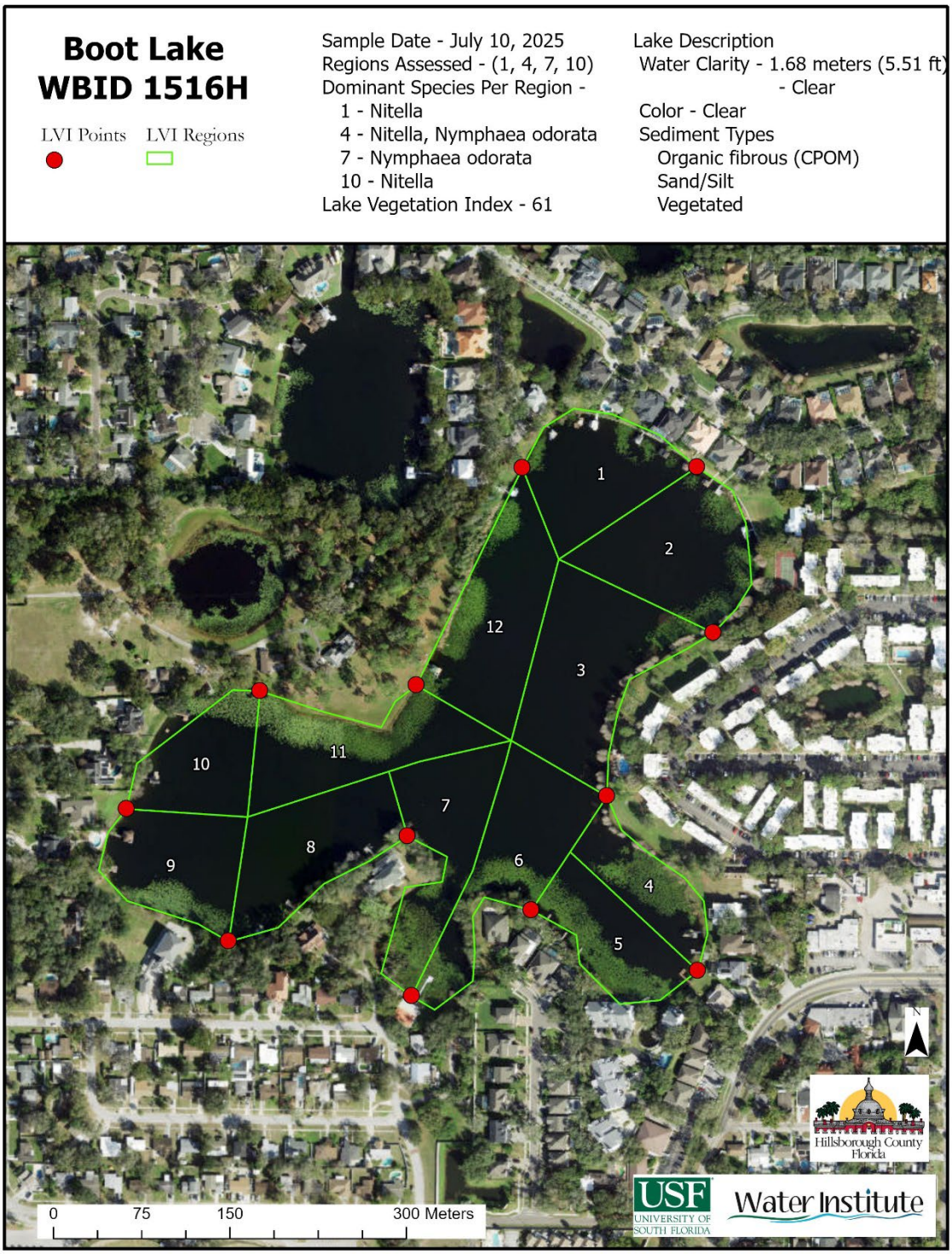

Figure 5 Boot Lake Lake Vegetation Index Sampling Map

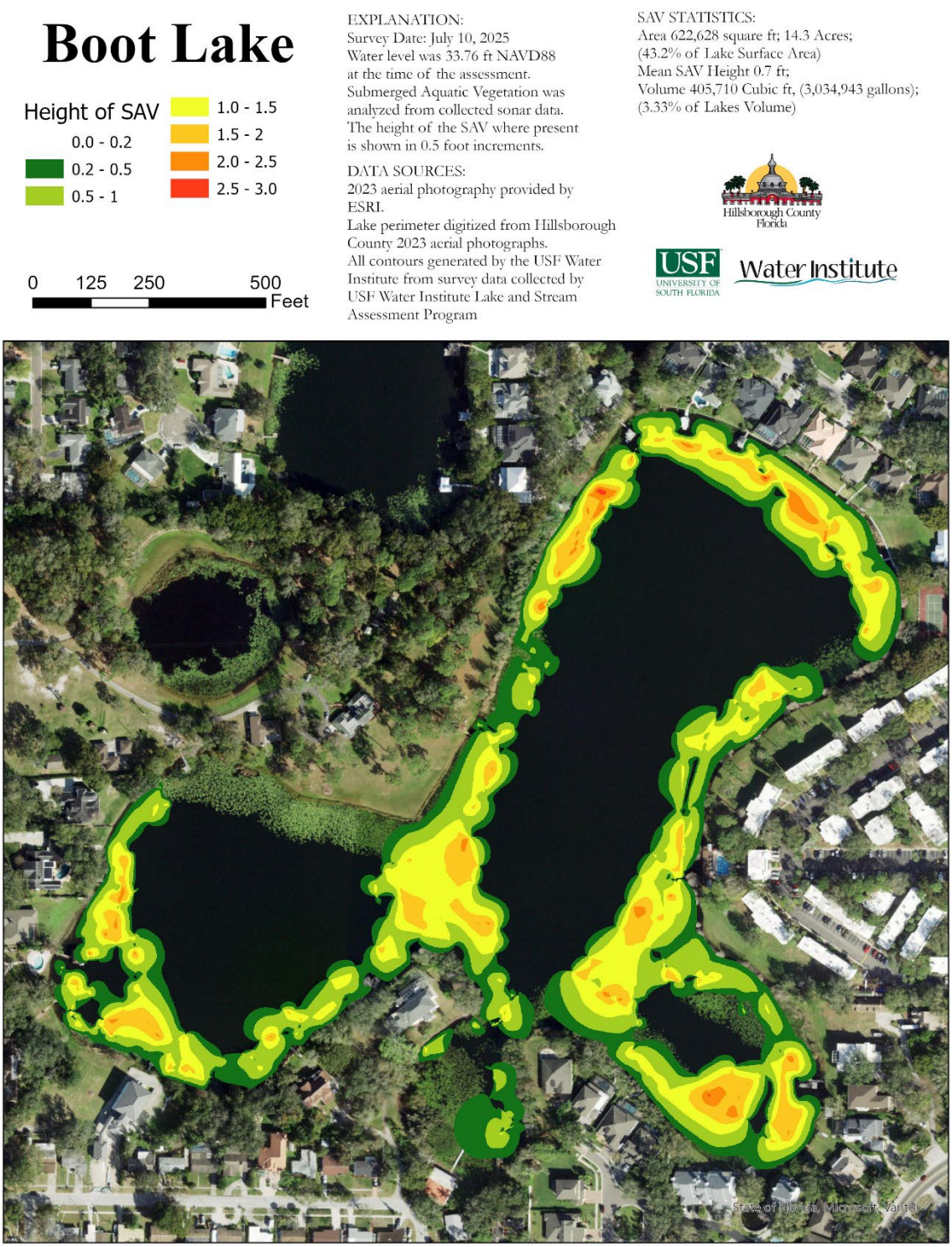

Figure 6: Boot Lake Sonar Derived Submersed Aquatic Vegetation Map

Table 2: Lake Vegetation Index results for Boot Lake July 10, 2025. In this table, "p" represents the taxa was present in the region while "c" and "d" denotes the taxa as being co-dominant or dominant in the vegetation region.

Taxon	Region				Occurrences	C of C Score	FLEPPC Status	Wetland Status	Nativity
	1	4	7	10					
Acer rubrum	*p*				*1*	4.65	Not Listed	FACW	Native
Alternanthera philoxeroides	*p*	*p*		*p*	*3*	0.00	Category 2	OBL	Exotic
Bacopa monnieri	*p*	*p*		*p*	*3*	3.50	Not Listed	OBL	Native
Casuarina equisetifolia			*p*	*p*	*2*	0.00	Category 1	FAC	Exotic
Cinnamomum camphora	*p*			*p*	*2*	0.00	Category 1	UPL	Exotic
Cyperus odoratus	*p*	*p*		*p*	*3*	3.00	Not Listed	FACW	Native
Cyperus polystachyos	*p*		*p*	*p*	*3*	1.56	Not Listed	FACW	Native
Cyperus prolifer			*p*	*p*	*2*	0.00	Category 2	FACW	Exotic
Cyperus surinamensis				*p*	*1*	2.03	Not Listed	FACW	Native
Eleocharis baldwinii		*p*	*p*	*p*	*3*	2.82	Not Listed	OBL	Native
Eleocharis submersed viviparous (species unknown)		*p*	*p*	*p*	*3*	3.00	Not Listed	OBL	Native
Eupatorium capillifolium	*p*			*p*	*2*	0.83	Not Listed	FAC	Native
Fuirena scirpoidea	*p*	*p*	*p*	*p*	*4*	5.50	Not Listed	OBL	Native
Hydrocotyle	*p*	*p*	*p*	*p*	*4*	2.00	Not Listed	FACW	Native
Ilex cassine			*p*		*1*	6.00	Not Listed	OBL	Native
Ludwigia arcuata				*p*	*1*	3.50	Not Listed	OBL	Native
Ludwigia octovalvis	*p*	*p*		*p*	*3*	2.00	Not Listed	OBL	Native
Ludwigia palustris	*p*	*p*		*p*	*3*	4.77	Not Listed	OBL	Native
Ludwigia peruviana			*p*	*p*	*2*	0.00	Category 1	OBL	Exotic
Melaleuca quinquenervia	*p*		*p*	*p*	*3*	0.00	Category 1	FAC	Exotic
Mikania scandens	*p*	*p*	*p*	*p*	*4*	1.95	Not Listed		Native

Taxon	Region				Occurrences	C of C Score	FLEPPC Status	Wetland Status	Nativity
	1	4	7	10					
Myrica cerifera	*p*		*p*		*2*	2.00	Not Listed	FAC	Native
Najas guadalupensis		*p*	*p*	*p*	*3*	5.07	Not Listed	OBL	Native
Nitella	*d*	*c*	*p*	*d*	*4*	6.00	Not Listed	OBL	Native
Nuphar			*p*		*1*	3.50	Not Listed	OBL	Native
Nymphaea odorata	*p*	*c*	*d*	*p*	*4*	5.00	Not Listed	OBL	Native
Panicum repens		*p*	*p*	*p*	*3*	0.00	Category 1	FACW	Exotic
Persea	*p*				*1*	-9.00	-9	Var Genus	Native
Persicaria hydropiperoides			*p*		*1*	2.50	Not Listed	OBL	Native
Pluchea baccharis		*p*		*p*	*2*	5.45	Not Listed	FACW	Native
Pontederia cordata	*p*	*p*	*p*	*p*	*4*	5.38	Not Listed	OBL	Native
Quercus laurifolia	*p*	*p*	*p*	*p*	*4*	4.00	Not Listed	FACW	Native
Quercus nigra	*p*				*1*	2.50	Not Listed	FACW	Native
Sagittaria lancifolia	*p*	*p*	*p*	*p*	*4*	3.00	Not Listed	OBL	Native
Salix caroliniana			*p*		*1*	2.95	Not Listed	OBL	Native
Schoenoplectus californicus			*p*		*1*	5.00	Not Listed	OBL	Native
Schoenoplectus tabernaemontani	*p*				*1*	5.55	Not Listed	OBL	Native
Sphagneticola trilobata	*p*			*p*	*2*	0.00	Category 2	FACW	Exotic
Taxodium	*p*	*p*	*p*	*p*	*4*	7.00	Not Listed	OBL	Native
Typha	*p*	*p*	*p*	*p*	*4*	1.00	Not Listed	OBL	Native
Utricularia gibba	*p*	*p*	*p*	*p*	*4*	6.37	Not Listed	OBL	Native
Utricularia inflata	*p*	*p*	*p*	*p*	*4*	5.85	Not Listed	OBL	Native
Vallisneria americana	*p*	*p*			*2*	7.00	Not Listed	OBL	Native

Table 3: Scoring Summary for the Lake Vegetation Index

LVI Sample Result:				61
Region	South			
Metric / Section	1	4	7	10
Total # Taxa	28	23	27	32
% Native Taxa	85.71	91.30	81.48	75.00
% FLEPPC 1 Taxa	3.57	4.35	14.81	12.50
% Sensitive Taxa	7.14	8.70	14.81	12.50
Dom Taxa Count	1	2	1	1
CofC Dom Taxa	6.00	5.50	5.00	6.00
Section LVI	70.77	75.68	49.44	47.96

Water Quality Assessment

Long-term water quality data is partially available for Boot Lake. The available data was collected by Lakewatch, Florida Department of Environmental Protection and Hillsborough County Environmental Services. Table 4 provides a summary of the Physical/Chemical conditions recorded at the middle of Boot Lake during the University of South Florida/ Hillsborough County Environmental Services assessment in 2025.

Table 4: Boot Lake Water Quality 7/10/2025 (Field)

Meter Readings:	Depth m	Temp (°C)	pH (SU)	D.O (mg/L)	D.O Sat. (%)	Cond. (µMho/cm)	Salinity (ppt)
Top:	0.5	29.7	6.98	5.56	73.9	197.6	0.09
Mid-Depth:	2.15	29.7	6.89	5.4	71.8	195.3	0.09
Bottom:	5.2	28.5	6.85	1.15	14.2	193.2	0.09

The chemical water quality analysis for Boot Lake is shown in Table 5. These values are the geometric mean value of available data for each annual period as well as the period of record. The FDEP Numeric Nutrient Criteria splits lakes into separate types based on color at 40 PCU. The "clear" water lakes below this value are further split into alkaline and acidic based on an alkalinity value of 20 mg/L $CaCO_3$. The long term color and alkalinity data are insufficient to accurately classify the lake, as such the remaining discussion will be utilizing the available data. The long term color data have a geometric mean value of 12.9 PCU, classifying it as a clear water lake (less than 40 PCU). Total Alkalinity period of record geometric mean value is 28.5 mg/L classifying it as an alkaline lake. The NNC thresholds for a clear lake with insufficient data to calculate NNC (Previous three years with at least 4 samples per year in separate seasons) are 20 µg/L for Chlorophyll-a Corrected for Phaeophytin, 0.03 mg/L for Total Phosphorous and 1.05 mg/L for Total Nitrogen.

Geometric mean Chlorophyll-a corrected values for the past three years are below the threshold with annual geometric means of 4.57 µg/L (2022), 5.94 µg/L (2023) and 3.17 µg/L (2024). The single 2025 sample was 6.4 µg/L. The period of record geometric mean for chlorophyll-a corrected is 3.63 µg/L.

Total Phosphorous geometric mean values for the most recent data were below the nutrient threshold for clear-alkaline lakes in the peninsula region with insufficient data with a value of 0.018 mg/l (2022), 0.019 mg/L (2023) and 0.017 mg/L (2024). The single 2025 sample was qualified as <0.068 mg/L. The period of record geometric mean for total phosphorous is 0.015 mg/L.

Total Nitrogen values were below the nutrient threshold for clear-alkaline lakes with insufficient data with a value of 0.506 mg/l (2022), 0.535 mg/L (2023) and 0.480 mg/L (2024). The single 2025 sample was 0.510 mg/L. The period of record geometric mean for total nitrogen is 0.547 mg/L.

Table 6 includes this data in the numeric nutrient criteria framework using the data from this assessment and the previous 3 years of data collected by Hillsborough County and Lakewatch.

Bacteria testing showed low levels of E. Coli (13.2 colonies/100ml) and low levels of Enterococci (69.9 colonies/100ml) exceeding 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: Boot Lake FDEP, Lakewatch and Hillsborough County Environmental Services Water Quality Results Laboratory Results

Parameter	2022	2023	2024	POR Mean Value	Units
Alkalinity	No Data	No Data	No Data	28.5	**mg/LCaCO3**
Color	22	14	No Data	12.9	**PCU**
E Coli	No Data	No Data	No Data	13.2	**#/100ml**
Enterococci	No Data	No Data	No Data	69.9	**#/100 ml**
Chlorophyll a	5.43	7.65	4.06	6.05	**ug/L**
Chlorophyll b	No Data	No Data	No Data	2.63	**ug/L**
Chlorophyll c	No Data	No Data	No Data	1.66	**ug/L**
Chlorophyll a Corrected	4.58	5.94	3.17	3.63	**ug/L**
Ammonia	No Data	No Data	No Data	0.018	**mg/L**
Nitrates/Nitrites	No Data	No Data	No Data	0.011	**mg/L**
Kjeldahl Nitrogen	No Data	No Data	No Data	0.538	**mg/L**
Total Nitrogen	0.506	0.535	0.480	0.547	**mg/L**
Total Phosphorus	0.018	0.019	0.017	0.015	**mg/L**

Table 6: Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean Color (pcu)	12.9
Number of Samples	62
Geometric Mean Alkalinity (mg/L $CACO_3$)	28.5
Number of Samples	5
Lake Type	Clear-Alkaline

Year (# of Samples)	Geomean Chla Corrected (µg/L)	Chlorophyll a Criteria (µg/L)	Geomean Total Phosphorous (mg/L)	Total Phosphorous Criteria (mg/L)	Geomean Total Nitrogen (mg/L)	Total Nitrogen Criteria (mg/L)
2022 (1)	4.58	< 20	0.018	< 0.03	0.506	< 1.05
2023 (1)	5.94	< 20	0.019	< 0.03	0.535	< 1.05
2024(2)	3.17	< 20	0.017	< 0.03	0.480	< 1.05

Conclusion

Boot Lake is a predominately residential lake in the Sweetwater Creek Watershed of Hillsborough County, Florida. The results of the assessment of Boot Lake shows healthy lake based on Chlorophyll-a, Total Nitrogen and Total Phosphorous concentrations according to the FDEP numeric nutrient criteria using a combination of Lakewatch and Hillsborough County Environmental Services datasets for the past three years, however data is insufficient to formally calculate numeric nutrient criteria.

The system does not show impairment in the vegetation communities according to the Lake Vegetation Index with few invasive species (8) and an overall LVI score of 61. The dominant species of vegetation were *Nitella* and *Nymphaea odorata*. The assessment revealed a submerged aquatic vegetation community comprising 6 species currently occupying only 43.2% of the surface area and 3.33% of the volume of Boot Lake.