



Lake Ellen

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

David Eilers | USF Water Institute | September 11, 2024

Methods

STUDY AREA ANALYSIS

The watershed containing Lake Ellen was analyzed using ESRI ArcGIS Pro. Using this software with 2022 ESRI Basemaps aerial, 2017 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 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 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.

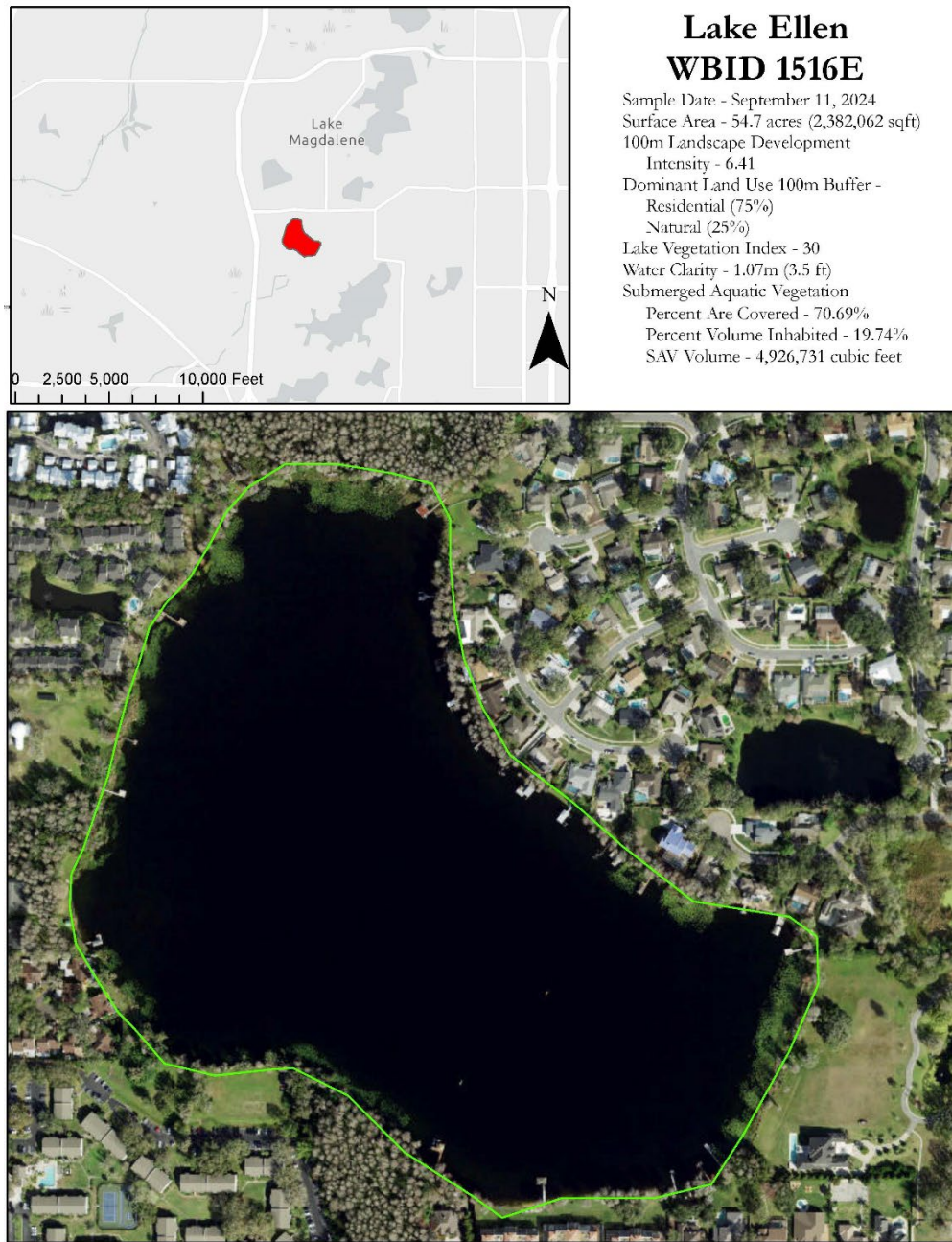
WATER QUALITY ASSESSMENT

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

Lake Ellen is located in the Coastal Old Tampa Bay Watershed in north-western Hillsborough County, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Lake Ellen is dominated by residential (75%) and natural (25%) land uses. The resulting LDI value for the 100 meter buffer around Lake Ellen is 6.41.

FIGURE 1: 2024 Lake Ellen ASSESSMENT STUDY AREA MAP



Lake Bathymetry and Morphological Characterization

At the time of the assessment, Lake Ellen was experiencing normal water levels (40.4 feet NAVD88 on staff gauge) resulting in a 54.7 acre water body. Lake Ellen at the time of the assessment had a mean water depth of 10.5 feet and a maximum observed depth of 21.91 feet. The volume at this time was approximately 186,745,306 gallons. Figure 2 shows the resulting bathymetric contour map for Lake Ellen from data collected on September 11, 2024. The collected data has been overlain the 2022 ESRI Basemap aerials.

Table 1: Morphological Calculations for Lake Ellen

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	2,382,062	221,299	54.7		
Mean Depth	10.5	3.19			
Maximum Depth	21.91	6.68			
Volume (cubic)	24,964,043	706,896		573.1	186,745,306
Gauge (NAVD 88)	40.4	12.31			

Figure 2: 2024 2-Foot Bathymetric Contour Map for Lake Ellen

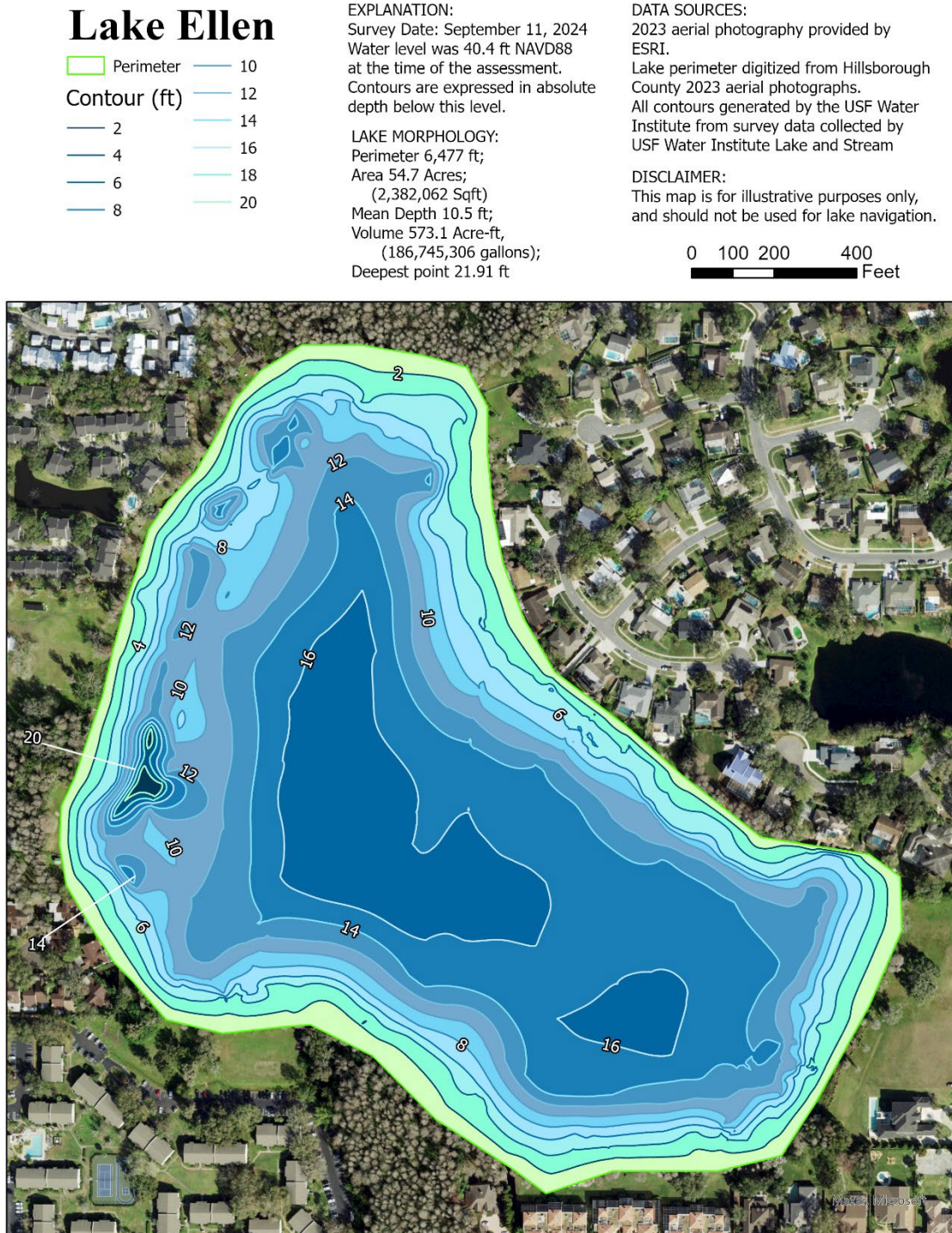




Figure 3 Overview photograph of Lake Ellen showing *Nuphar* which was present at segments 5 and 8

Lake Habitat and Lake Vegetation Index Assessment

The lake assessment for Lake Ellen was conducted on September 11, 2024. The water in Lake Ellen was characterized as green with slightly turbid water. The secchi disk depth was 1.1 meters allowing for the growth of submerge aquatic vegetation. The vegetation quality of the plants in and buffering Lake Ellen are predominantly native species with extensive growths of the non-native invasive species *Panicum repens* as it was present in all regions but dominate in region 2. The percentage of non-native FLEPPC 1 species ranged from 10% (region 11) to 23.81% (region 8). Stormwater reaches the lake predominately via ditches, pipes, and cultivated vegetation and has a few BMPs. The development along the shoreline has maintained the nearshore *Taxodium* however the shrub and native ground cover communities have been maintained for residential turf grasses. The bottom substrate quality was dominated by sand with coarse particulate organic matter near shore and contained submersed vegetation.



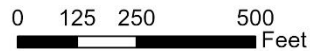
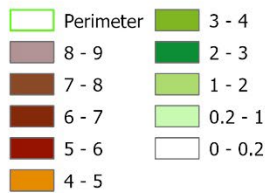
Figure 4 Hydrilla verticillata collected with the Frotus rake, considered dominate in all segments

The Lake Vegetation Index identified 38 species of wetland vegetation growing in the four selected sections along Lake Ellen. The majority of these species (29) are native species. The remaining 9 species (*shown in **bold** in Table 2*) are non- native or invasive to this region. The vegetation community along the shorelines of Lake Ellen has been altered by lawn maintenance activities leaving a *Taxodium* canopy with a sparse shrub and ground cover community. The edges of the lake are dominated by species able to rapidly colonize following the frequent disturbance of mowing, such as *Panicum repens*. At the time of the assessment the water transparency was 1.07 m (3.5 ft). Low annual average secchi disk depths lead to a littoral zone being dominated by submersed vegetation. Among the submersed vegetation found, *Hydrilla verticillata*. The floating leaved vegetation *Hydrocotyle* and *Nuphar* were found in two of the four regions.

By analyzing the collected sonar chart, submerged aquatic vegetation potentially covered approximately 70.69% of the surface area of Lake Ellen. This submerged vegetation inhabits an estimated 19.74% of the water volume in Lake Ellen. Figure 5 shows the results of the SAV analysis indicating the location and height of SAV estimated from collected sonar readings.

The calculated LVI score for Lake Ellen was 30, below the impairment threshold of 43 indicating the vegetation community is showing evidence of being “Impaired”. Figure 6 shows the map of Lake Ellen detailing the LVI regions used for the assessment (Regions 2, 5, 8, 11). Table 2 details the species list results of the Lake Vegetation Index. Table 3 details the scoring result for the Lake Vegetation Index.

Lake Ellen



EXPLANATION:

Survey Date: September 11, 2024
 Water level was unknown at the time of the assessment.
 Submerged Aquatic Vegetation was analyzed from collected sonar data.
 The height of the SAV where present is shown in 1 foot increments.

DATA SOURCES:

2023 aerial photography provided by ESRI.
 Lake perimeter digitized from Hillsborough County 2023 aerial photographs.
 All contours generated by the USF Water Institute from survey data collected by USF Water Institute Lake and Stream Assessment Program

SAV STATISTICS:

Area 1,683,919 square ft; 38.7 Acres;
 (70.69% of Lake Surface Area)
 Mean SAV Height 2.9 ft;
 Volume 4,926,731 Cubic ft, (36,854,760 gallons);
 (19.74 % of Lakes Volume)



Water Institute

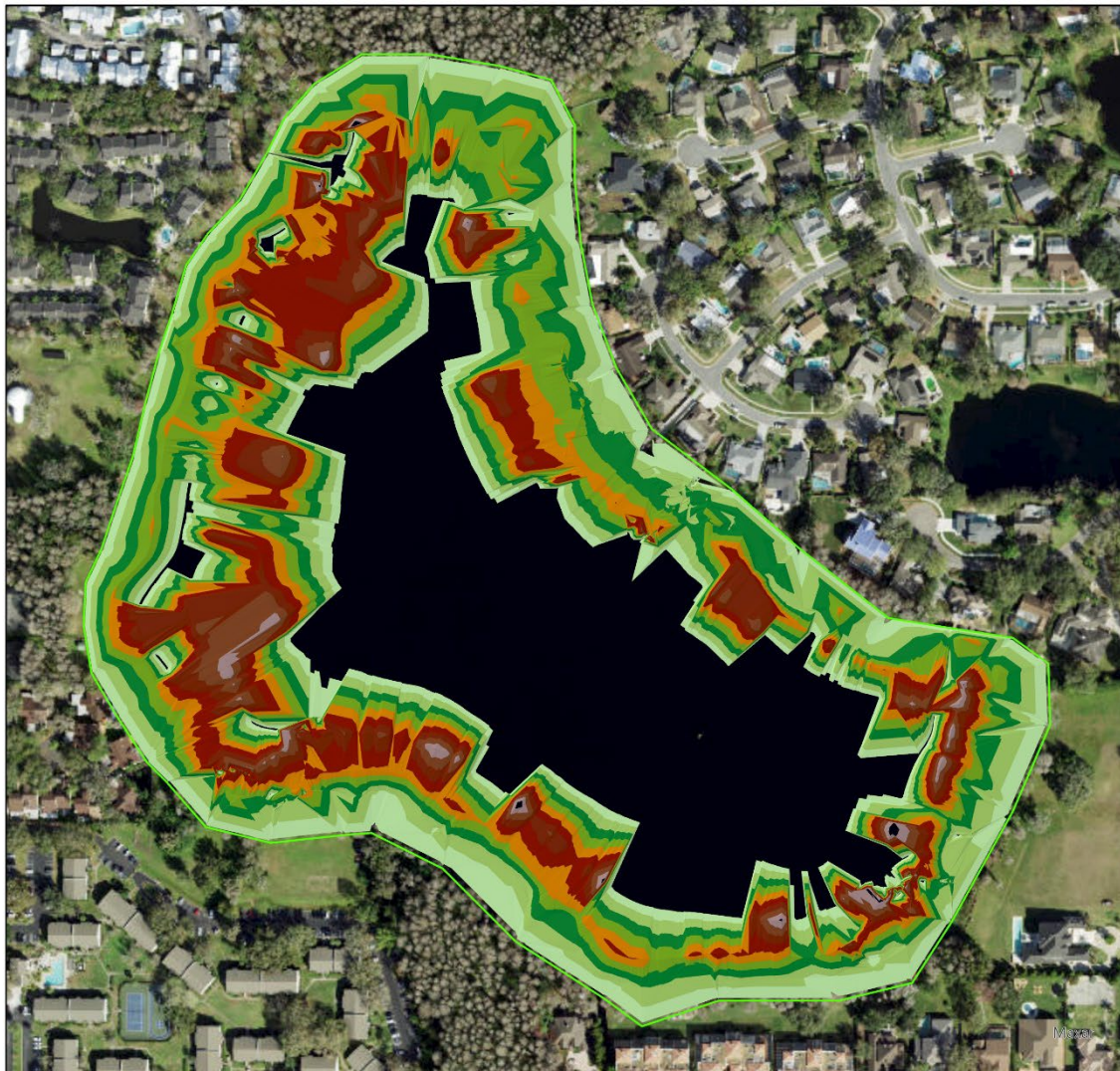


Figure 5 Lake Ellen Submerged Aquatic Vegetation Assessment Results

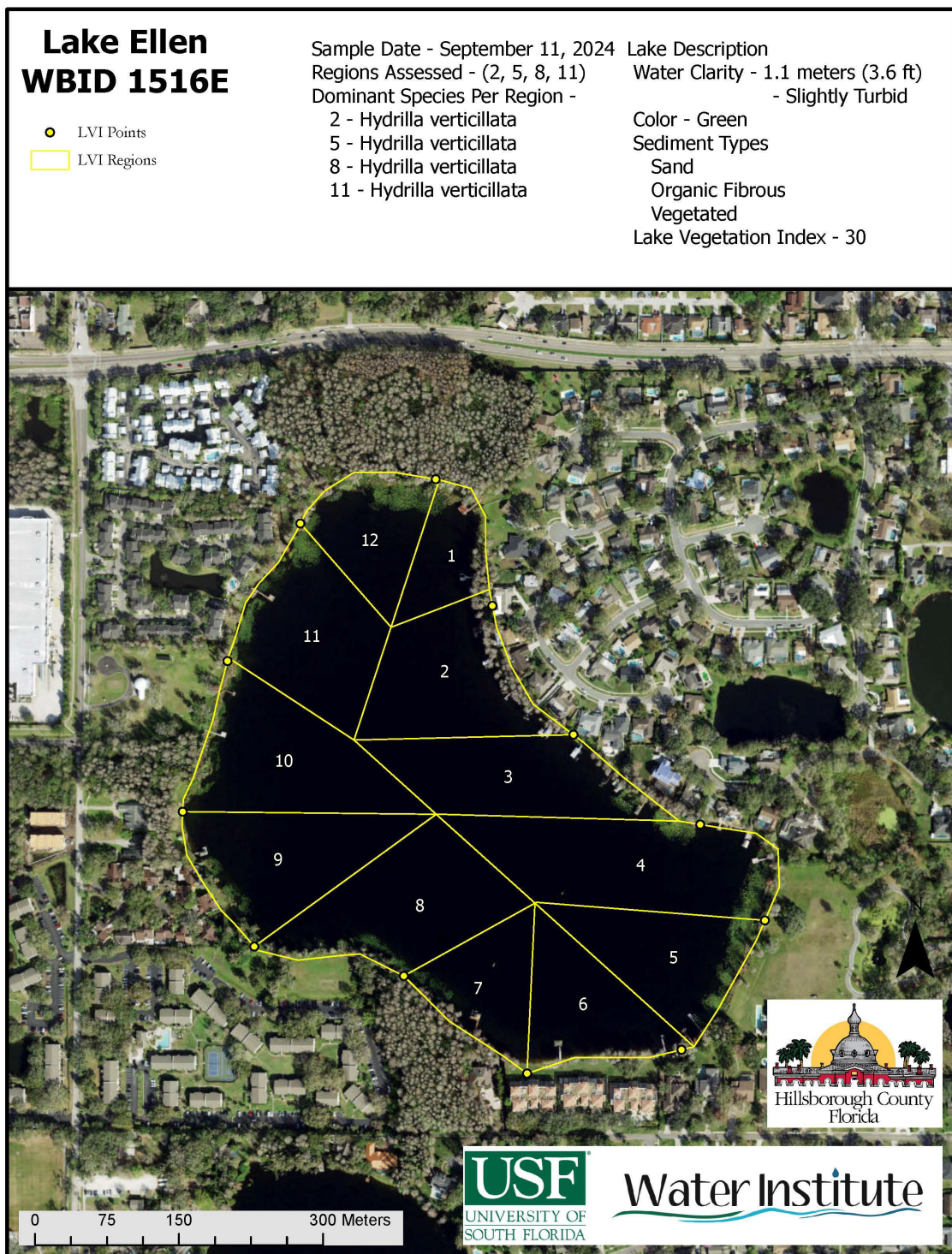


Figure 6: Lake Vegetation Index region map for Lake Ellen

Table 2: Lake Vegetation Index results for Lake Ellen September 11, 2024. 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	Regions				Occurrences	C of C Score	FLEPPC Status	Wetland Status	Nativity
	2	5	8	11					
<i>Acer rubrum</i>	P	P	P	P	4	4.65	Not Listed	FACW	Native
<i>Acrostichum danaeifolium</i>			P		1	5.79	Not Listed	OBL	Native
<i>Albizia</i>		P			1	-9	Split Genus		-9
<i>Blechnum serrulatum</i>	P				1	5.5	Not Listed	FACW	Native
<i>Boehmeria cylindrica</i>	P		P		2	5	Not Listed	OBL	Native
<i>Casuarina equisetifolia</i>			P		1	0	Category 1	FAC	Exotic
<i>Cephalanthus occidentalis</i>			P		1	5	Not Listed	OBL	Native
<i>Chara</i>			P		1	3.9	Not Listed	OBL	Native
<i>Cinnamomum camphora</i>				P	1	0	Category 1	UPL	Exotic
<i>Cyperus polystachyos</i>	P				1	1.56	Not Listed	FACW	Native
<i>Diodia virginiana</i>	P				1	3	Not Listed	FACW	Native
<i>Eupatorium capillifolium</i>		P			1	0.83	Not Listed	FAC	Native
<i>Hydrilla verticillata</i>	D	D	D	D	4	0	Category 1	OBL	Exotic
<i>Hydrocotyle</i>	P		P		2	2	Not Listed	FACW	Native
<i>Imperata cylindrica</i>			P		1	0	Category 1		Exotic
<i>Ludwigia leptocarpa</i>		P		P	2	3	Not Listed	OBL	Native
<i>Ludwigia octovalvis</i>			P	P	2	2	Not Listed	OBL	Native
<i>Ludwigia peruviana</i>		P			1	0	Category 1	OBL	Exotic

Taxon	Regions				Occurrences	C of C Score	FLEPPC Status	Wetland Status	Nativity
	2	5	8	11					
<i>Melaleuca quinquenervia</i>	<i>P</i>	<i>P</i>	<i>P</i>		3	0	Category 1	FAC	Exotic
<i>Mikania scandens</i>		<i>P</i>		<i>P</i>	2	1.95	Not Listed		Native
<i>Myrica cerifera</i>			<i>P</i>	<i>P</i>	2	2	Not Listed	FAC	Native
<i>Nuphar</i>		<i>P</i>	<i>P</i>		2	3.5	Not Listed	OBL	Native
<i>Nymphaea odorata</i>		<i>P</i>			1	5	Not Listed	OBL	Native
<i>Oxycaryum cubense</i>		<i>P</i>		<i>P</i>	2	0	Not Listed	OBL	Exotic
<i>Panicum repens</i>	<i>P</i>	<i>P</i>	<i>P</i>	<i>P</i>	4	0	Category 1	FACW	Exotic
<i>Paspalidium geminatum</i>			<i>P</i>		1	5.5	Not Listed	OBL	Native
<i>Persicaria hydropiperoides</i>				<i>P</i>	1	2.5	Not Listed	OBL	Native
<i>Pontederia cordata</i>	<i>P</i>			<i>P</i>	2	5.38	Not Listed	OBL	Native
<i>Quercus laurifolia</i>		<i>P</i>		<i>P</i>	2	4	Not Listed	FACW	Native
<i>Sagittaria lancifolia</i>		<i>P</i>	<i>P</i>	<i>P</i>	3	3	Not Listed	OBL	Native
<i>Salix caroliniana</i>				<i>P</i>	1	2.95	Not Listed	OBL	Native
<i>Schinus terebinthifolius</i>			<i>P</i>		1	0	Category 1	FAC	Exotic
<i>Taxodium</i>	<i>P</i>	<i>P</i>	<i>P</i>	<i>P</i>	4	7	Not Listed	OBL	Native
<i>Thelypteris palustris pubescens</i>				<i>P</i>	1	5.31	Not Listed	FACW	Native
<i>Typha</i>		<i>P</i>		<i>P</i>	2	1	Not Listed	OBL	Native
<i>Utricularia gibba</i>	<i>P</i>	<i>P</i>	<i>P</i>	<i>P</i>	4	6.37	Not Listed	OBL	Native
<i>Vallisneria americana</i>	<i>P</i>	<i>P</i>	<i>P</i>	<i>P</i>	4	7	Not Listed	OBL	Native
<i>Vitis rotundifolia</i>			<i>P</i>	<i>P</i>	2	1.18	Not Listed		Native

Table 3: Scoring Summary for the Lake Vegetation Index

LVI Sample Result: 30				
Region		South		
Metric / Section	2	5	8	11
Total # Taxa	13	18	21	20
% Native Taxa	77%	67%	71%	80%
% FLEPPC 1 Taxa	23%	22%	24%	10%
% Sensitive Taxa	15%	11%	10%	10%
Dom Taxa Count	1	1	1	1
CofC Dom Taxa	0	0	0	0
Section LVI	35	20	22	42

Water Quality Assessment

Long-term water quality data is available for Lake Ellen. The available data was collected by Lakewatch, Southwest Florida Water Management District, 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 the Lake Ellen during the assessment in 2024.

Table 4: Lake Ellen Water Quality 9/11/2024 (Field)

Meter Readings:	Depth (M)	Temp (°C)	pH (SU)	D.O (MG/L)	D.O Sat. (%)	Cond. (UMHO/CM)	Salinity (PPT)
Top:	0.42	30.35	8.5	8.64	116	218	0.01
Mid-Depth:	2.9	28.9	7.77	6.85	89.1	217	0.01
Bottom:	5.6	26.01	6.93	1	2.5	278	0.01

The chemical water quality analysis for Lake Ellen is shown in Table 5 for the samples taken on 9/11/2024. Table 6 includes this data in the numeric nutrient criteria framework using the data from this assessment. The long term color data have a geometric mean value of 27 PCU, classifying it as a clear water lake (greater than or equal to 40 PCU). Total Alkalinity period of record geometric mean value is 43 mg/L. The NNC thresholds for a clear lake with sufficient 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, 0.03-0.09 mg/L for Total Phosphorous and 10.5-1.91 mg/L for Total Nitrogen.

There is a lack of data for the previous three years, and insufficient data for the year 2024. The geometric mean Chlorophyll-a corrected value for 2024 is 2.55 µg/L, the total Phosphorous geometric mean for 2024 is 0.068 mg/L, and the total Nitrogen geometric mean for 2024 is 0.78 mg/L.

Bacteria testing showed low levels of Enterococci (2.92 colonies/100ml) and no data for E Coli. 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 Ellen 2024 Hillsborough County Environmental Services Water Quality Results (Laboratory)

Parameter	2022	2023	2024	POR Mean Value	Units
Alkalinity	No data	No data	42.2	43	mg/LCaCO₃
Color	No data	No data	No data	27	PCU
E Coli	No data	No data	No data	No data	#/100ml
Enterococci	No data	No data	2.92	4.84	#/100 ml
Chlorophyll a	No data	No data	10.03	11.48	ug/L
Chlorophyll b	No data	No data	2.55	1.39	ug/L
Chlorophyll c	No data	No data	2.61	2.08	ug/L
Chlorophyll a Corrected	No data	No data	8.55	8.52	ug/L
Ammonia	No data	No data	0.073	0.051	mg/L
Nitrates/Nitrites	No data	No data	No data	No data	mg/L
Kjeldahl Nitrogen	No data	No data	0.782	0.771	mg/L
Total Nitrogen	No data	No data	0.781	0.771	mg/L
Total Phosphorus	No data	No data	0.068	0.054	mg/L

Table 6: Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean Color (pcu)	27
Number of Samples	21
Geometric Mean Alkalinity (mg/L CaCO ₃)	43
Number of Samples	27
Lake Type	Clear

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 (0)	No data	< 20	No data	< 0.03	No data	< 1.05
2023 (0)	No data	< 20	No data	< 0.03	No data	< 1.05
2024 (6)	8.58	< 20	0.068	< 0.03	0.781	< 1.05

Conclusion

Lake Ellen is a predominately residential lake in the Coastal Old Tampa Bay Watershed of Hillsborough County, Florida. The results of the assessment of Lake Brant 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, Southwest Florida Water Management District and Hillsborough County Environmental Services datasets.

The system does show impairment in the vegetation communities according to the Lake Vegetation Index with abundant invasive species (10) and an overall LVI score of 30. The assessment also revealed a submerged aquatic vegetation community comprising 4 species occupying 70.69% of the surface area and 19.74% of the volume of Lake Ellen.