Lake Virginia

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 Virginia was analyzed using ESRI ArcGIS 10.6. Using this software with 2020ESRI 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 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.

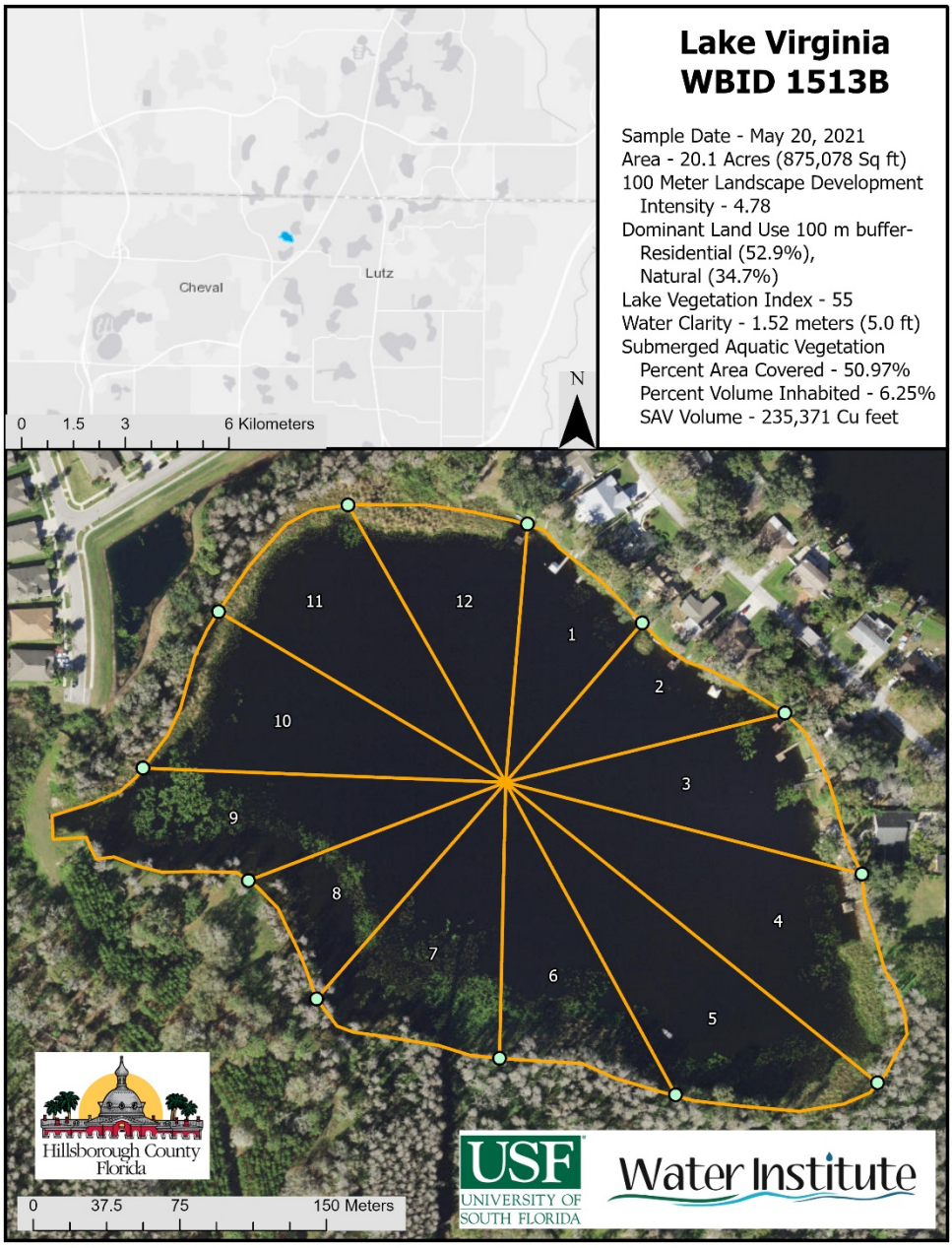
WATER QUALITY ASSESSMENT

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, 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 Virginia 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 Virginia is dominated by Residential (52.9%), Natural (34.7%) and Silviculture (12.4%) land uses. The resulting LDI value for the 100 meter buffer around Lake Virginia is 4.78.

FIGURE 1: 2021 Lake Virginia ASSESSMENT STUDY AREA MAP



Lake Bathymetry and Morphological Characterization

At the time of the assessment, Lake Virginia was experiencing normal water levels (58.98 feet above sea level NAVD 88) resulting in a 20.1 acre water body. Lake Virginia at the time of the assessment had a mean water depth of 4.3 feet and a maximum observed depth of 17.29 feet. The volume at this time was approximately 28,184,827 gallons. Figure 2 shows the resulting bathymetric contour map for Lake Virginia from data collected on May 20, 2021. The collected data has been overlain the 2020 Hillsborough County aerials.

Table 1: Morphological Calculations for Lake Virginia

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	875,078	81,297	20.1		
Mean Depth	4.3	1.31			
Maximum Depth	17.29	5.27			
Volume (cubic)	3,767,737	106,689		86.5	28,184,827
Gauge (NAVD 88)	58.98	17.98			

Figure 2: 2021 1-Foot Bathymetric Contour Map for Lake Virginia

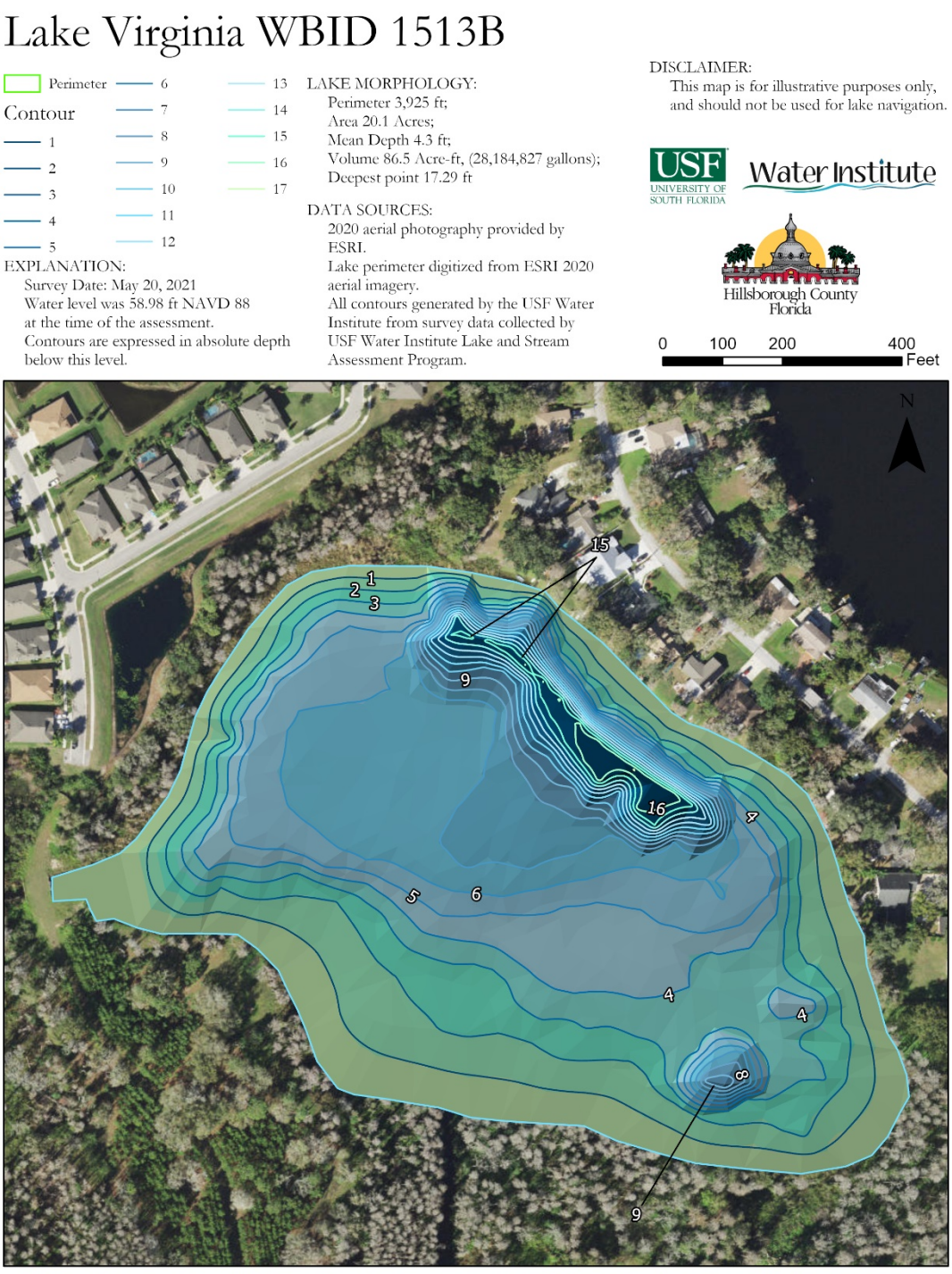


Figure 3 Overview photograph of Lake Virginia showing typical shoreline vegetation

Lake Habitat and Lake Vegetation Index Assessment

The lake assessment for Lake Virginia was conducted on May 20, 2021. The water in Lake Virginia was characterized as colored with a color value of 50 PCU. The secchi disk depth was 1.52 meters in part due to the tannins and turbidity. The vegetation quality of the plants in and buffering Lake Virginia are predominantly native species with minor growths of non-native nuisance species such as *Limnophila sessiliflora, Panicum repens and Lugwigia peruviana*. Stormwater reaches the lake via sheet flow from surrounding land cover. The bottom substrate quality was dominated by sand with coarse particulate organic matter near shore. The Lake Virginia shoreline features a mixture of residential properties and natural buffers. Along these natural buffers, diversity was elevated. Along the residential properties the emergent vegetation community was greatly reduced.

Figure 4 Limnophila sessiliflora was seen occasionally on Lake Virginia

The Lake Vegetation Index identified 43 species of wetland vegetation growing in the four selected sections along Lake Virginia. The majority of these species (34) are native species. The remaining 9 species (*indicated in bold in table 2*) are non- native and invasive to this region. The vegetation community along Lake Virginia is dominated by a variety of emergent species including *Pontederia cordata* and *Ludwigia leptocarpa.* The water's surface in Lake Virginia was dominated by *Nuphar* and *Nymphaea odorata*. A total of ten species of submerged aquatic vegetation were observed, *Eleocharis (submersed viviparous), Utricularia inflata, Utricularia gibba, Utricularia radiata, Potamogeton pusillus, Nitella, Limnophila sessiliflora, Bacopa caroliniana, Hydrilla verticillata* and *Najas guadalupensis* with *Eleocharis* being dominant or co-dominant in all four regions of the LVI. Submerged vegetation was abundant in Lake Virginia in part due to abundant available light and suitable bottom substrates. By analyzing the collected sonar chart, submerged aquatic vegetation potentially covered approximately 50.97% of the surface area of Lake Virginia. This submerged vegetation inhabits an estimated 6.25% of the water volume in Lake Virginia. 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 Virginia was 55, above the impairment threshold of 43 indicating that the vegetation community is "Healthy". Figure 6 shows the map of Lake Virginia 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.

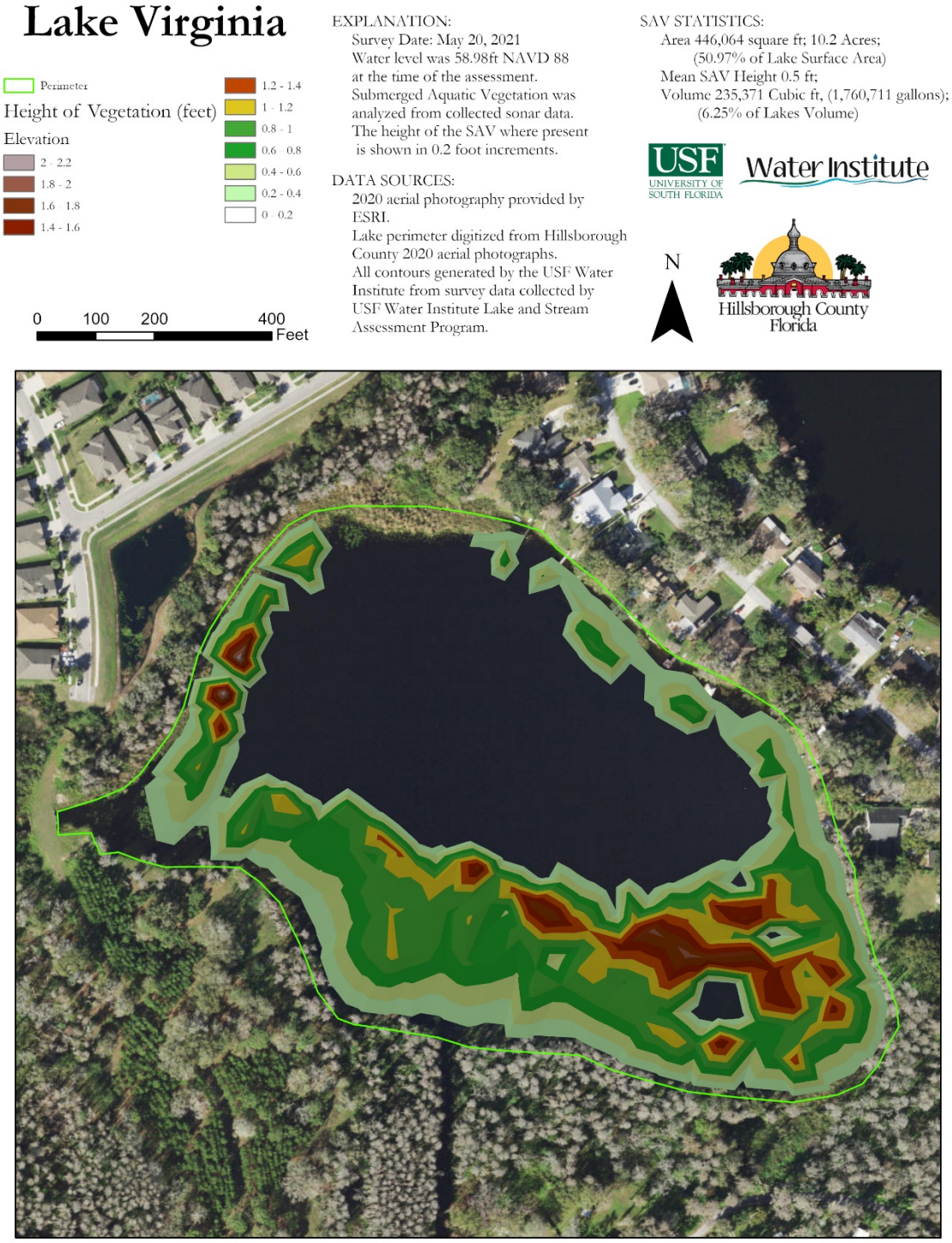


Figure 5 Lake Virginia Submerged Aquatic Vegetation Assessment Results

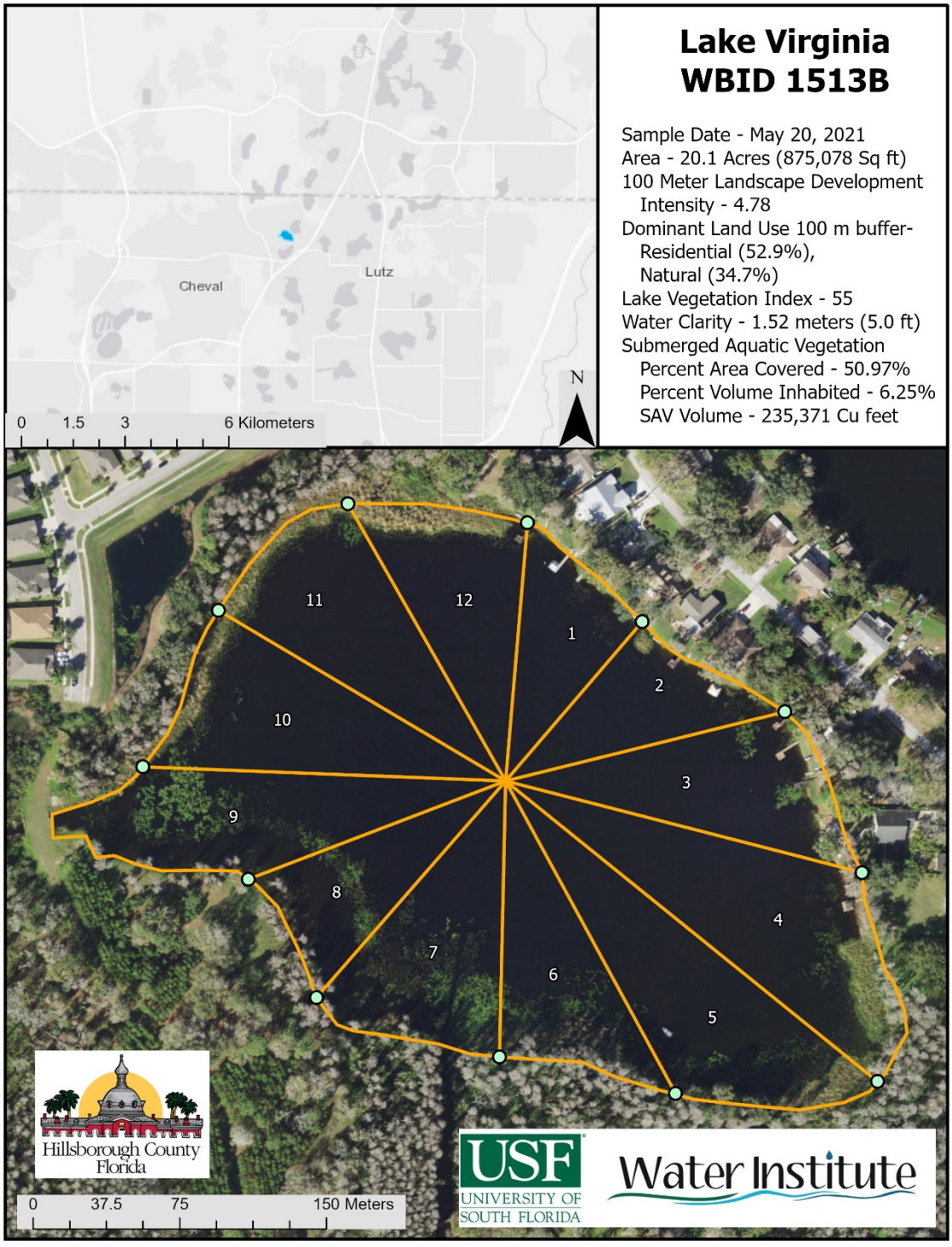


Figure 6: Lake Vegetation Index region map for Lake Virginia

Table 2: Lake Vegetation Index results for Lake Virginia May 20, 2021

SPECIES	CofC	1	4	7	10
Eleocharis (submersed viviparous but unable to ID to species)	3.00	C	D	C	C
Hydrocotyle	2.00	1	1	1	1
Ludwigia leptocarpa	3.00	1	1	1	1
Luziola fluitans	4.00	1	1	1	1
Najas guadalupensis	5.07	1	1	1	1
Nitella	6.00	1	1	1	1
Nuphar	3.50	1	1	1	C
Nymphaea odorata	5.00	1	1	1	1
Pontederia cordata	5.38	1	1	1	1
Utricularia gibba	6.37	1	1	1	1
Utricularia inflata	5.85	C	1	C	1
Blechnum serrulatum	5.50		1	1	1
Cephalanthus occidentalis	5.00		1	1	1
Limnophila sessiliflora	0.00	1	1	1	
Ludwigia peruviana	0.00		1	1	1
Mikania scandens	1.95	1	1	1	
Myrica cerifera	2.00		1	1	1
Nymphoides aquatica	6.09	1		1	1
Oxycaryum cubense	0.50		1	1	1
Panicum hemitomon	5.82		1	1	1
Panicum repens	0.00	1	1	1	
Potamogeton pusillus	7.80	1	1	1	
Taxodium	7.00		1	1	1
Utricularia radiata	6.01	1	1	1	
Alternanthera philoxeroides	0.00	1			1
Bacopa caroliniana	4.50		1		1
Cyperus polystachyos	1.56	1	1		
Persea palustris	7.00			1	1
Salvinia minima	0.00			1	1
Thelypteris interrupta	6.74			1	1
Typha	1.00			1	1
Cyperus odoratus	3.00	1			
Eleocharis baldwinii	2.82	1			
Fuirena breviseta	3.50	1			
Hydrilla verticillata	0.00	1			
Ilex cassine	6.00			1	
Juncus marginatus	1.50	1			
Juncus megacephalus	3.50	1			
Liquidambar styraciflua	2.50			1	
Ludwigia arcuata	3.50	1			
Melaleuca quinquenervia	0.00			1	
Persicaria hydropiperoides	2.50	1			
Sapium sebiferum	0.00				1

Table 3: Scoring Summary for the Lake Vegetation Index

LVI Score Summary	1	4	7	10
Total # of taxa in sampling unit	27	25	31	26
% Native taxa in sampling unit	85.18519	84	80.64516	80.76923
% FLEPPC CAT 1 taxa in sampling unit	7.407407	8	12.90323	11.53846
% Sensitive taxa in sample unit	3.703704	8	9.677419	7.692308
Dominant CoC in sample unit	4.425	3	4.425	3.25

Native Score ((x-62.5)/37.5) or ((x-66.67)/25.89)=	0.715148	0.66937	0.53979	0.544582
Invasive FLEPPC 1 Score (1 - (x/30))=	0.753086	0.733333	0.569892	0.615385
Sensitive Score (x/(27.78 or 20)) =	0.185185	0.4	0.483871	0.384615
Dominant CoC Score (x/(7.91 or 7)) =	0.632143	0.428571	0.632143	0.464286
Raw Score Total = N+I+S+D =	2.285563	2.231275	2.225696	2.008868
Division Factor = (3 D=0 or 4) =	4	4	4	4
Average LVI dividend = Raw /DF	0.571391	0.557819	0.556424	0.502217
South				
LVI Score for sampling unit =	57.13906	55.78188	55.64241	50.2217

Total LVI SCORE = 55

Water Quality Assessment

Limited long-term water quality data is available for Lake Virginia. The available data was collected by FDEP, Hillsborough County and University of Florida LAKEWATCH program (1995-2021), however this dataset is incomplete with recent years having sparse data. There were no nutrient samples available from August 2017 until 2021. As part of this assessment four samples were taken during May, June, July and August of 2021. Table 4 provides a summary of the Physical/Chemical conditions recorded at the middle of the Lake Virginia during the assessment in 2021.

Table 4: Lake Virginia Water Quality (Field)

Date	Depth (m)	Temp °C	pH	DO (mg/L)	DO (%sat)	Cond (unho/cm)	Salinity (ppt)	Secchi Depth (m)
5/20/21	0.31	26.81	7.68	7.13	88.3	155.8	0.07	1.52
5/20/21	1.39	26.76	7.44	7.01	86.7	155.8	0.07	
5/20/21	2.34	26.4	7.47	6.64	81.6	155.3	0.07	
6/9/21	0.5	30.1	8.00	6.91	91.6	175	0.08	
7/28/21	0.5	31.1	7.63	4.85	65.4	165	0.08	
8/10/21	0.5	29.5	6.74	3.97	52.1	168	0.08	

The chemical water quality analysis for Lake Virginia is shown in Table 5 for the samples taken on 5/20/21, 6/9/21, 7/28/21 and 8/10/21. Table 6 includes this data in the numeric nutrient criteria framework using the data from this assessment as well as the available geometric mean values for the period of record since complete data for the past three years for available parameters is not available. Color values for the period of record data have a geometric mean value of 56.29 PCU, classifying it as a colored water lake (less than or equal to 40 PCU). Total Alkalinity period of record geometric mean value is 22.96 mg/L classifying the lake as alkaline (greater than or equal to 20 mg/L). The NNC thresholds for a colored, alkaline lake with insufficient data to calculate NNC (Previous three years with at least 3 samples per year in separate seasons) are 20 µg/L for Chlorophyll-a Corrected for Phaeophytin, 0.05 mg/L for Total Phosphorous and 1.27 mg/L for Total Nitrogen.

Geometric mean Chloropyll-a corrected values for the 2021 data is 1.07 µg/L. Period of record Chlorophyll-a corrected geometric mean was 3.88 µg/L. Total Phosphorous mean values for the most recent data were inconclusive of the nutrient threshold for colored lakes in the west central region with insufficient data with a value of <0.068 mg/l due to the four samples carrying QA qualifiers indicating a value below the minimum detection limit for the method used. The geometric mean value for the period of record is 0.043 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 0.760 mg/l for the most recent data. The geometric mean for the period of record was 1.535 mg/L.

Bacteria testing from the four 2021 samples showed low levels of E. Coli (5.84 colonies/100ml) and Enterococci (3.19 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 Virginia 2021 Water Quality Results (Laboratory)

Parameter	5/20/2021	6/9/2021	7/28/2021	8/10/2021	POR Mean Value	Units
Alkalinity	27.2	23.4	32.6	30.5	22.96	**mg/LCaCO3**
E Coli	4.1	6.3	4.1	11.0	5.84	**#/100ml**
Enterococci	3.1	2.0	2.0	8.4	3.19	**#/100 ml**
Chlorophyll a	5.1	8.1	13.4	11.5	39.62	**ug/L**
Chlorophyll b	1.3	1	1	1	1.3	**ug/L**
Chlorophyll c	1.3	1	1.1	1	1.1	**ug/L**
Chlorophyll t	5.1	8.1	14.5	11.5	9.8	**ug/L**
Chlorophyll a Corrected	1.3	1	1	1	3.88	**ug/L**
Ammonia	<0.073	<0.073	<0.073	<0.073	0.011	**mg/L**
Nitrates/Nitrites	<0.043	<0.043	<0.043	<0.043	0.005	**mg/L**
Kjeldahl Nitrogen	0.749	0.723	0.775	0.794	1.004	**mg/L**
Total Nitrogen	0.750	0.720	0.780	0.790	1.535	**mg/L**
Total Phosphorus	<0.068	<0.068	<0.068	<0.068	0.043	**mg/L**

Table 6: Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	56.29
Number of Samples	36
Geometric Mean Alkalinity (mg/L $CACO_3$)	22.96
Number of Samples	27
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 (3-year), only 2021 data available	3.88
Geomean TP mg/L (3-year), only 2021 data available	< 0.068
Geomean TN mg/L (3-year), only 2021 data available	0.760
Number of Samples (3-year)	4
Potential Impaired Chlorophyll a	Not Impaired
Potential Impaired TP	Inconclusive
Potential Impaired TN	Not Impaired

Conclusion

The results of the assessment of Lake Virginia shows a healthy lake based on Total Nitrogen and Chlorophyll-a corrected concentrations according to the FDEP numeric nutrient criteria using the four samples taken during this assessment. 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 inconclusive for the nutrient threshold as the minimum detection limit of the method used was not suitable. The system also shows health in the vegetation communities according to the Lake Vegetation Index with high overall species (43), moderate occurrences of non-native, invasive species and few sensitive plant species with an overall LVI score of 55. The assessment also revealed abundant submerged aquatic vegetation community comprising ten species occupying 50.97% of the surface area and 6.25% of the volume of Lake Virginia.