Avis Lake

Methods

Study Area Analysis

The watershed containing Avis 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**[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 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 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 taxon 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

Avis Lake is located within the Coastal Old Tampa Bay Watershed between Lake Carroll to the north and White Trout Lake to the South in the community of Carrollwood, Hillsborough County, Florida. The surface area of Avis Lake is approximately 1.71 acres at the time of the assessment. The Landscape Development Intensity Index of the 100 meter buffer around Avis Lake is dominated by residential (99.9%) land use. The resulting LDI value for the 100 meter buffer around Avis Lake is 33.1.

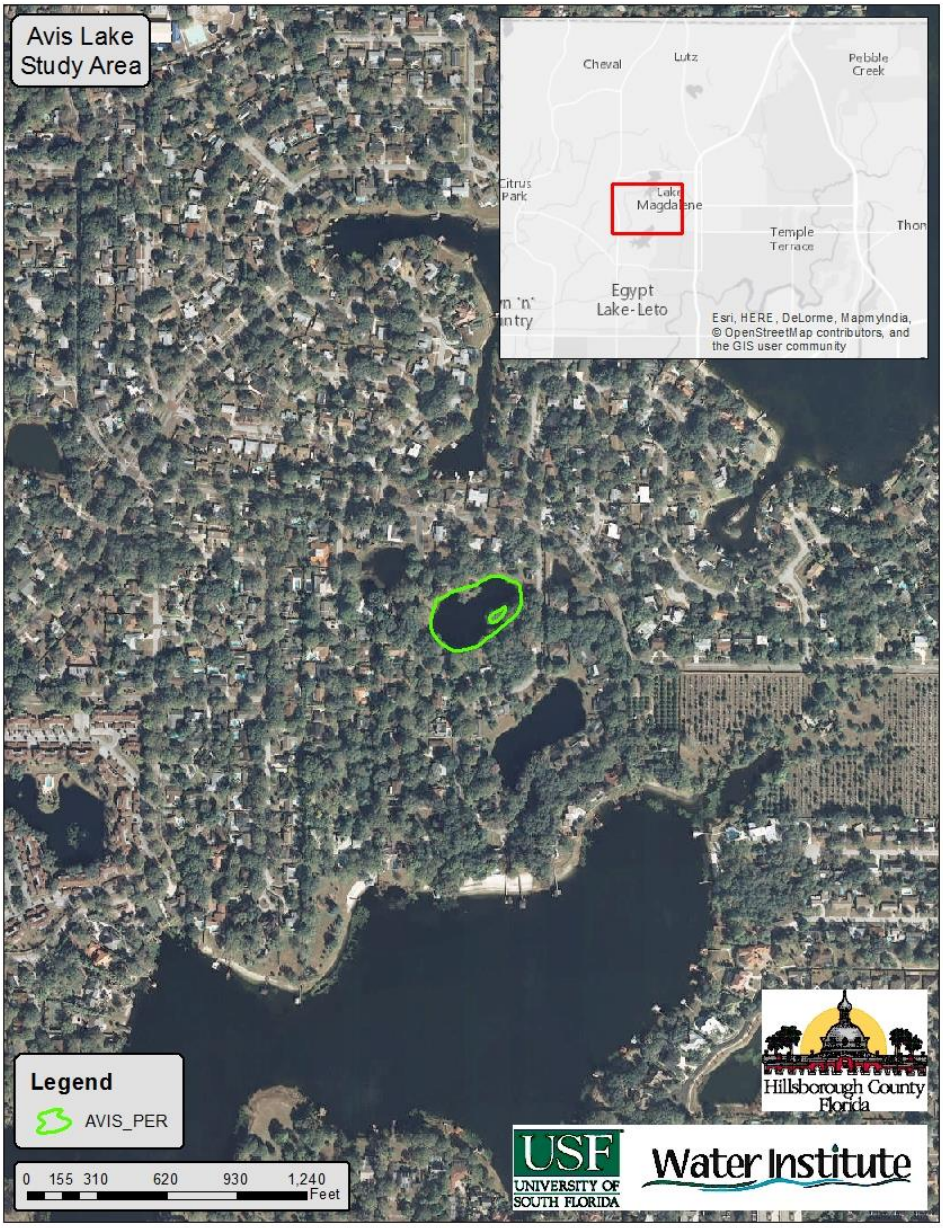

Figure 1 2015 Avis Lake Assessment Study Area Map

Lake Bathymetry and Morphological Characterization

Avis Lake is a relatively deep system with a small surface area. The basin of the lake is characterized by two separate depressions in the eastern and western portions of the basin with the western portion significantly deeper. Avis Lake at the time of the assessment had a mean water depth of 5.81 feet and a maximum observed depth of 13.29 feet. The volume at this time was approximately 3,244,734 gallons. Figure 2 shows the resulting bathymetric contour map for Avis Lake from data collected on July, 29, 2015. The collected data has been overlain the 2011 Hillsborough County aerials.

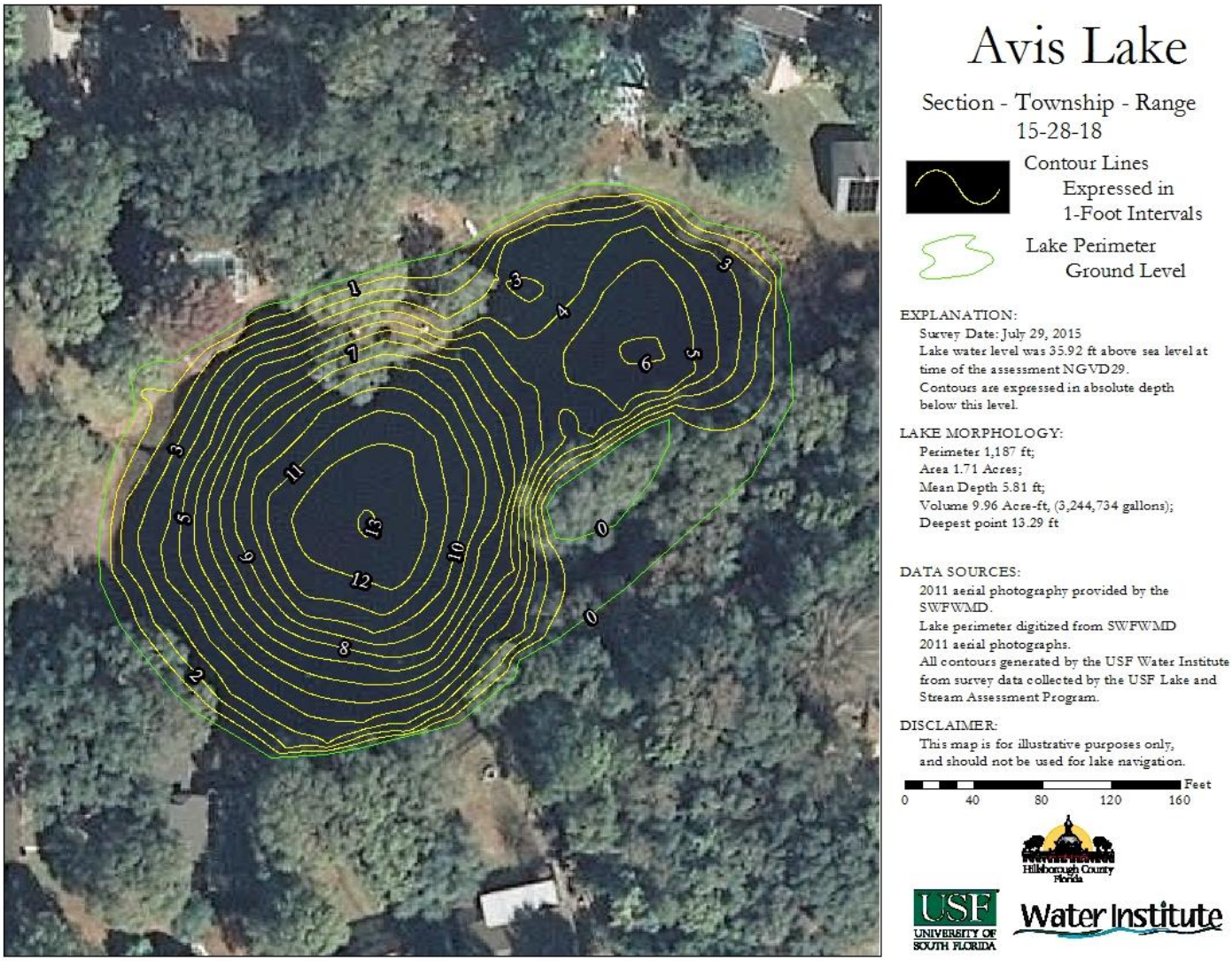

Figure 2 2015 Bathymetric Contour Map for Avis Lake

Table 1 Morphological Calculations for Avis Lake

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	74,673	6,937	1.71	0	0
Mean Depth	5.81	1.63	0	0	0
Maximum Depth	13.29	3.73	0	0	0
Volume (cubic)	433,755	12,283	0	9.96	3,244,734
Gauge (relative)	35.92	10.09	0	0	0

Lake Vegetation Index Assessment

Figure 3 Overview photograph of Avis Lake

The lake assessment for Avis Lake was conducted on July 29, 2015. Avis Lake received a lake habitat assessment (FEDP form FD 9000-6) score of 66 due to marginal scores for Stormwater Inputs, Lakeside Adverse Human Alterations and Adverse Watershed Land Use. Poor scores were recorded for Upland Buffer Zone. Suboptimal scores were recorded for Secchi, Vegetation Quality and Bottom Substrate Quality.

Figure 4 Much of the shoreline of Avis Lake was clearcut for turf grasses, removing the vegetation buffer surrounding the lake.

The Lake Vegetation Index identified 31 species of wetland vegetation growing in the four selected sections along Avis Lake. The majority of these species (25) are native species. The remaining 6 species (*Panicum repens, Hydrilla verticillata, Schinus terebinthiflius, Alternanthera philoxeroides, Commelina diffusa* and *Ludwigia peruviana*) are non-native and invasive to this region. The vegetation community along Avis Lake is dominated by *Panicum repens* in region 1 and *Salix caroliniana* in region 4. Regions 7 and 10 showed no dominant or codominant species. The water's surface in Avis Lake was dominated by *Nuphar advena* and *Nymphoides aquatic*. The water column of the lake was dominated by *Hydrilla verticillata* and two species of bladderworts (*Utricularia foliosa* and *Utricularia gibba*). By analyzing the collected sonar chart, submerged aquatic vegetation covered approximately 27% of the surface area of Avis Lake. This submerged vegetation inhabits an estimated 3.57% of the water volume in Avis Lake. Figure 6 shows the map of Avis Lake detailing the LVI regions used for the assessment. Table 1 details the species list results of the Lake Vegetation Index. Table 2 details the scoring result for the Lake Vegetation Index. Avis Lake received a Lake Vegetation Index score of 23, classifying it as having an impaired vegetation community compared to the LVI threshold of 37.

Figure 5 *Bacopa caroliniana* on Avis Lake

Figure 6 ***Floating algal mats were commonly observed on Avis Lake33***

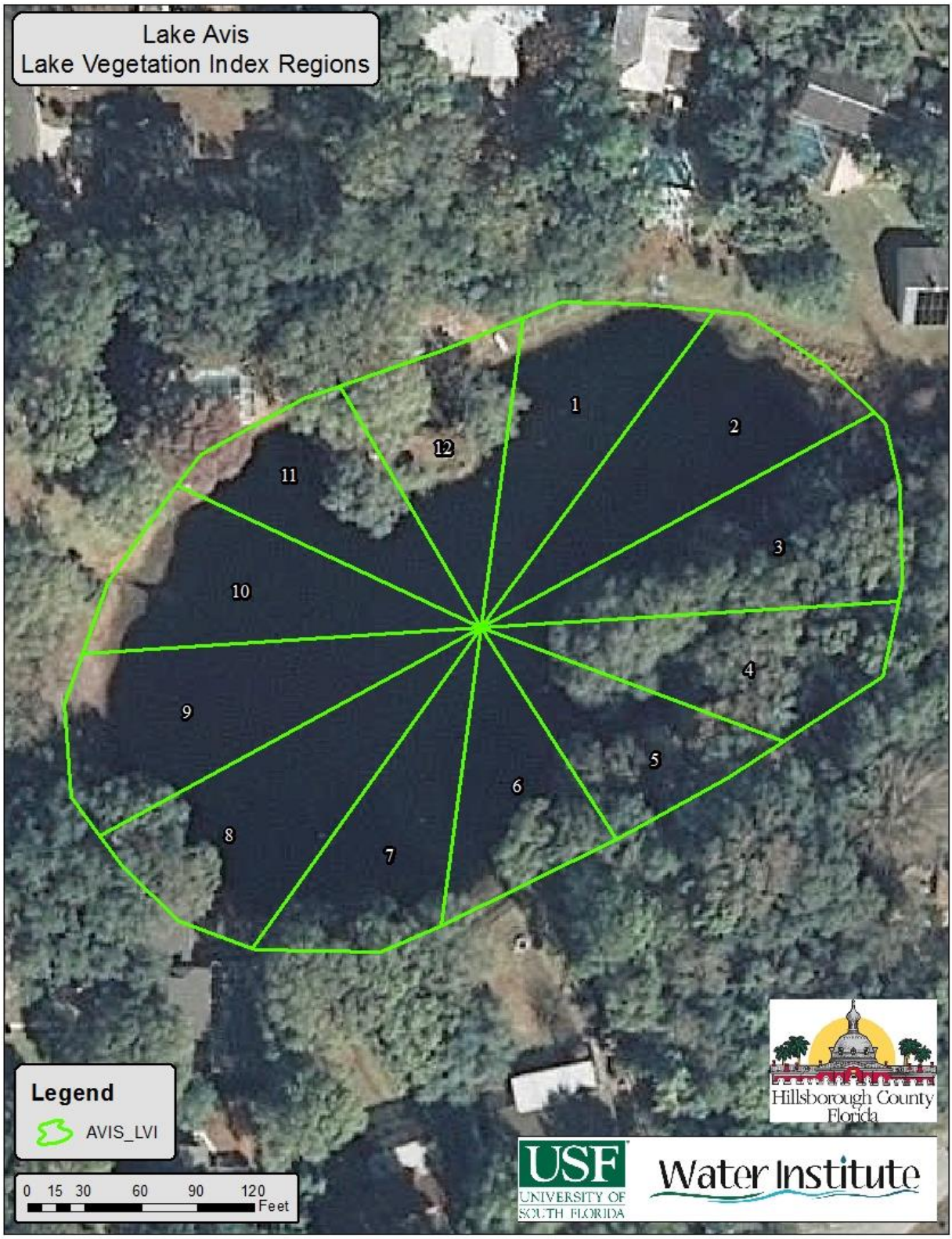

Figure 7 Lake Vegetation Index region map for Avis Lake

Table 2 Lake Vegetation Index results for Avis Lake 7/29/2015

SPECIES	Region				
	CofC	1	4	7	10
Alternanthera philoxeroides	0			1	1
Bacopa caroliniana	4.5	1	1		1
Bacopa monnieri	3.5				1
Blechnum serrulatum	5.5		1		
Boehmeria cylindrica	5		1	1	
Centella asiatica	1.92				1
Commelina diffusa	2.02				1
Cyperus polystachyos	1.56	1			
Diodia virginiana	3	1			
Eleocharis baldwinii	2.82	1	1	1	1
Hydrilla verticillata	0	1	1	1	1
Hydrocotyle	2	1		1	1
Iris virginica	5.5			1	
Lemna	1	1	1		
Liquidambar styraciflua	2.5				1
Ludwigia arcuata	3.5				1
Ludwigia peruviana	0	1	1	1	
Ludwigia repens	3.2	1			
Micranthemum glomeratum	5.85			1	
Mikania scandens	1.95			1	
Myrica cerifera	2		1		
Nephrolepis exaltata	3		1		
Nuphar	3.5	1	1		
Nymphoides aquatica	6.09	1		1	
Panicum repens	0	D			1
Persea palustris	7		1		
Quercus laurifolia	4	1	1		1
Salix caroliniana	2.95		D		
Schinus terebinthifolius	0		1		
Utricularia floridana	6.34			1	
Utricularia gibba	6.37		1		

Table 3 Scoring Summary for the Lake Vegetation Index

LVI Score Summary	Region			
	1	4	7	10
Total # of taxa in sampling unit	13	15	11	12
% Native taxa in sampling unit	76.92308	80	72.72727	66.66667
% FLEPPC CAT 1 taxa in sampling unit	23.07692	20	18.18182	16.66667
% Sensitive taxa in sample unit	0	6.66667	0	0
Dominant CoC in sample unit	0	2.95	NULL	NULL
Native Score ((x-62.5)/37.5) or ((x-66.67)/25.89)=	0.396025	0.514871	0.233962	0
Invasive FLEPPC 1 Score (1 - (x/30))=	0.230769	0.333333	0.393939	0.444444
Sensitive Score (x/(27.78 or 20)) =	0	0.333333	0	0
Dominant CoC Score (x/(7.91 or 7)) =	0	0.421429	0	0
Raw Score Total = N+I+S+D =	0.626794	1.602966	0.627901	0.444444
Division Factor = (3 D=0 or 4) =	4	4	3	3
Average LVI dividend = Raw /DF	0.156698	0.400741	0.2093	0.148148
South				
LVI Score for sampling unit =	15.66985	40.07415	20.93004	14.81481
Total LVI SCORE =	23			

Water Quality Assessment

Long-term water quality data is not available for Avis Lake. The available data was collected was a single measurement of phosphorous and nitrogen from 5/18/1990. Since the available data is insufficient, the water quality discussion will be limited to the current conditions at the time of the assessment. Table 4 provides a summary of the Physical water conditions in the middle of the lake at the time of the assessment.

Depth (m)	Temp ©	pH	DO (mg/L)	DO (% Sat)	Cond (umho/cm)	Salinity (ppt)	TDS (mg/L)	Secchi Depth (m)
0.2	29.29	7.14	6.78	87.6	165.9	0.08	106.1	84.73
1.63	28.91	7.03	5.61	71.9	164.1	0.08	105	84.03
3.86	28.4	6.62	1.33	17	155.3	0.07	99.4	83.13

Table 4 Avis Lake Water Quality (Field)

The chemical water quality analysis for Avis Lake is shown in Table 5 for the sample taken on July 29, 2015. Total Phosphorous values were below the nutrient threshold for clear alkaline lakes developed by FDEP of 0.03 mg/l with a value of 0.025 mg/l. Total Nitrogen values were also below the nutrient threshold for clear alkaline lakes developed by FDEP of 1.05 mg/l with a value of 0.696 mg/l. Chlorophyll-a values fall below the nutrient threshold for clear alkaline lakes developed by FDEP of 20.0 µg/l with a three a value of 8.5 µg/l. Table 6 shows the Numeric Nutrient Criteria analysis for Avis Lake.

Bacteria testing showed low levels of Fecal Coliform (40 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 Avis Lake Water Quality Results from 6/23/2015(Laboratory)

Parameter	Value	Units
Alkalinity	36	mg/LCaCO3
Nitrates/Nitrites	0.013	mg/L
Fecal Coliform	40	#/100 ml
Enterococci	90	#/100 ml
Chlorophyll a	11	ug/L
Chlorophyll b	2.6	ug/L
Chlorophyll c	2.7	ug/L
Chlorophyll t	15.9	ug/L
Chlorophylla Corr	8.5	ug/L
Chlorophyll-pheo	3.8	ug/L
Ammonia	0.021	mg/L
Kjeldahl Nitrogen	0.683	mg/L
Total Nitrogen	0.696	mg/L
Total Phosphorus	0.025	mg/L
Color(345)F.45	8.3	Pt/Co

Table 6 Numeric Nutrient Criteria Analysis

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	8.3
Number of Samples	1
Geometric Mean Alkalinity (mg/L CACO3)	36
Number of Samples	1
Lake Type	Clear Alkaline
Chlorophyll a Criteria (ug/L)	20
Insufficient for Geomean Criteria then P mg/L	0.03
Insuffcient for Geomean Criteria then N mg/L	1.05
Geomean Chla ug/L	8.5
Geomean TP mg/L	0.025
Geomean TN mg/L	0.696
Number of Samples	1
Potential Impaired Chlorophyll a	Not Impaired
Potential Impaired TP	Not Impaired
Potential Impaired TN	Not Impaired

Conclusion

The results of the assessment of Avis Lake does not show impairment based on the FDEP numeric nutrient criteria threshold values for Chlorophyll-a, Nitrogen or Phosphorous based on the single sample from this assessment. Additional samples would be required to obtain NNC values per the FDEP. The system does show impairment in the vegetation communities according to the Lake Vegetation Index with a low number of individual species, a high percentage of FLEPPC type 1 plants and few sensitive species present with an overall LVI score of 23. Of concern in the vegetation communities is the presence of *hydrilla verticillata* in the submerged vegetation. This species has the ability to out-compete other native species and form a monoculture covering the majority of the lakes surface area. The vegetative community would also benefit from establishing a buffer zone between the turf grass lawns and the aquatic habitats of the lake.