Lake Ellen

Methods

Study Area Analysis

The watershed containing Lake Ellen 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.

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[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 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.

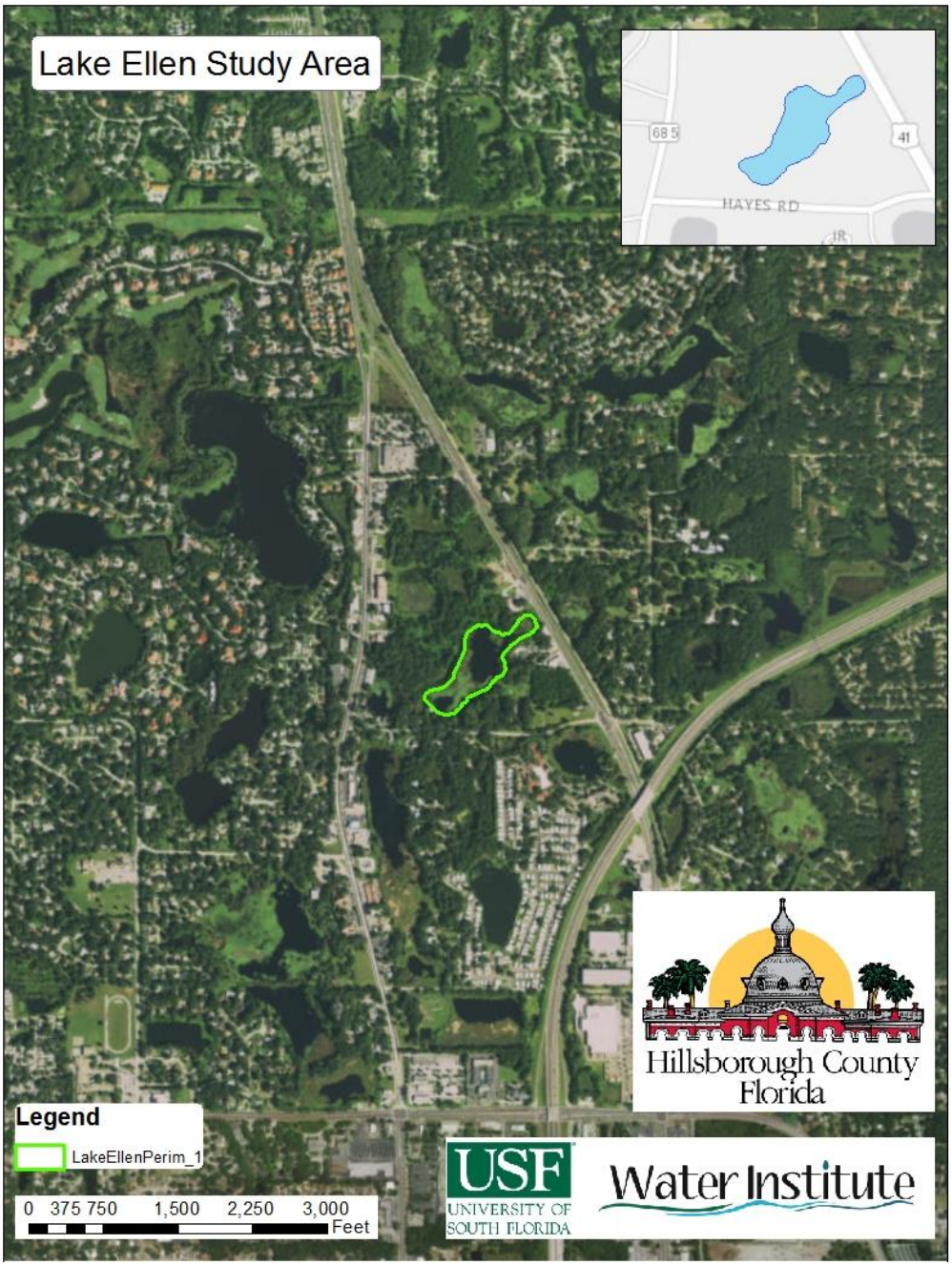
Water Quality Assessment

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 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

Lake Ellen is located west of US Highway 41 in the Lutz area of Hillsborough County, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Lake Ellen is dominated by Natural Lands (46.3%), Residential land use (29.4%). The remaining areas within this buffer include and Commercial/Services (16%) and Transportation (7.27%) land uses. The resulting LDI value for the 100 meter buffer around Lake Ellen is 4.33.

Figure 1: 2017 Lake Ellen Assessment Study Area Map



Lake Bathymetry and Morphological Characterization

Ellen Lake is a small, moderately deep lake in the Lutz area of Hillsborough County. At the time of the assessment, Ellen Lake was experiencing moderately high water levels resulting in a 9.3 acre water body. A staff gage was not available for a measurement of lake elevation. Ellen Lake at the time of the assessment had a mean water depth of 6.2 feet and a maximum observed depth of 17.99 feet. The volume at this time was approximately 18,836,429 gallons. Figure 2 shows the resulting bathymetric contour map for Ellen Lake from data collected on June 29, 2017. The collected data has been overlain the 2016 Hillsborough County aerials.

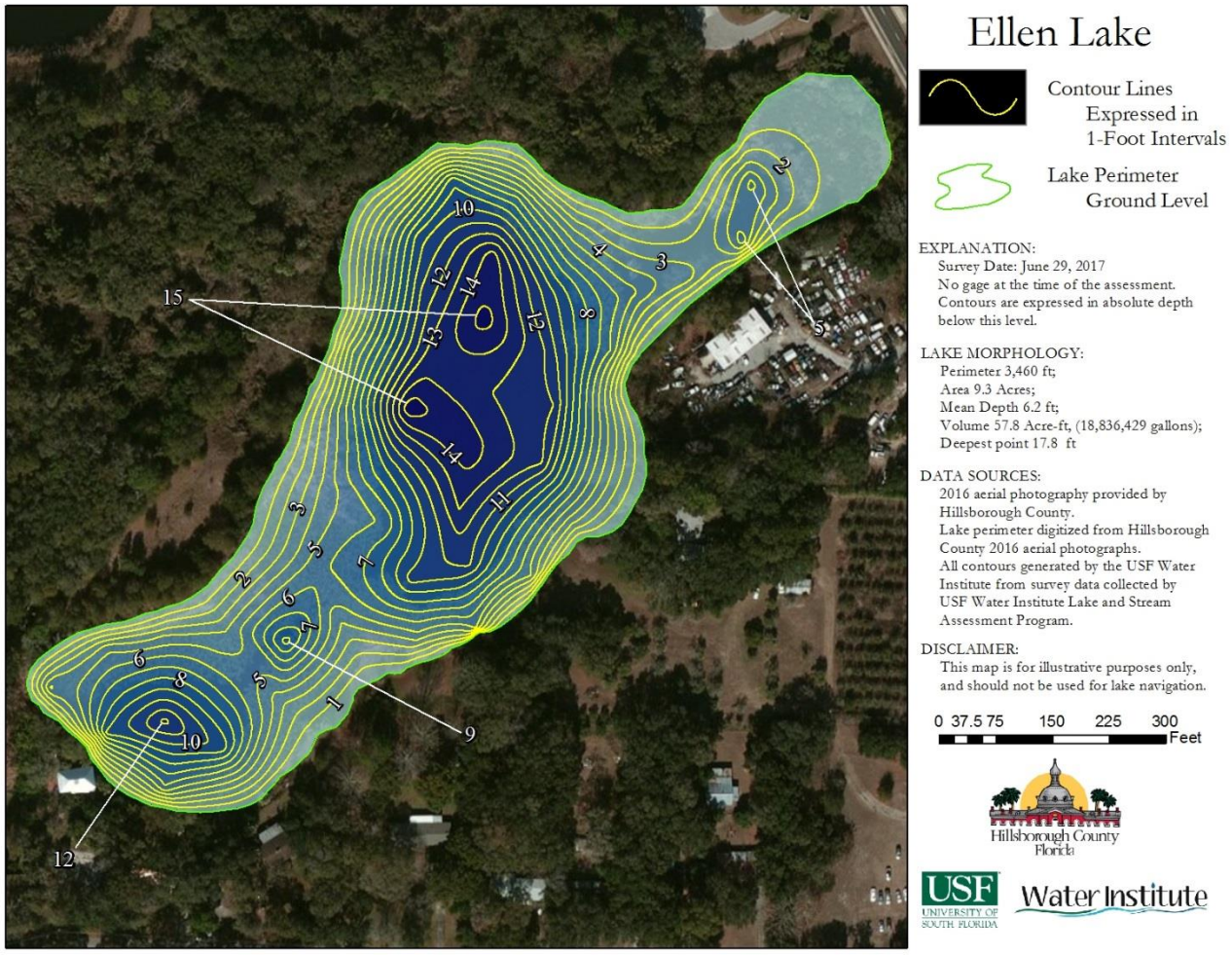


Figure 2: 2017 1-Foot Bathymetric Contour Map for Ellen Lake

Table 1: Morphological Calculations for Ellen Lake

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	406,419	37,757	9.3	0	0
Mean Depth	6.2	1.89	0	0	0
Maximum Depth	17.99	5.48	0	0	0
Volume (cubic)	2,518,047	71,302	0	57.8	18,836,429
Gauge (NGVD 88)	NA	NA	0	0	0

Lake Vegetation Index Assessment

Figure 3 Overview photograph of Ellen Lake

The lake assessment for Ellen Lake was conducted on June 29, 2017. At the time of the assessment, Lake Ellen had dense growth of emergent and floating leaved vegetation throughout the lake, restricting access in the northeast lobe. Ellen Lake received a lake habitat assessment (FEDP form FD 9000-6) score of 76 due to suboptimal scores for Secchi, Lakeside Adverse Human Alterations, Upland Buffer Zone and Adverse Watershed Land Use. Vegetation Quality, Stormwater Inputs and Bottom Substrate Quality achieved Marginal scores.

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

The Lake Vegetation Index identified 27 species of wetland vegetation growing in the four selected sections along Ellen Lake. The majority of these species (19) are native species. The remaining 8 species (*Alternanthera philoxeroides, Melaleuca quinquenervia, Oxycaryum cubense, Salvinia minima, Colocasia esculenta, Schinus terebinthifolius, Sphagneticola trilobata* and *Ludwigia peruviana*) are non-native and invasive to this region. The vegetation community along Ellen Lake is dominated by a variety of emergent species including *Typha, Oxycaryum cubense,* and *Melaleuca quinquenervia.* The water's surface in Ellen Lake was dominated by *Nymphaea odorata* (Figure 5). No species of submerged aquatic vegetation was observed by visual or frodus sampling at the time of the assessment. By analyzing the collected sonar chart, submerged aquatic vegetation potentially covered approximately 6.3% of the surface area Ellen Lake. This submerged vegetation inhabits an estimated 0.1% of the water volume in Ellen Lake.

The calculated LVI score for Ellen Lake was 20, below the impairment threshold of 37. Figure 6 shows the map of Ellen 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.

Figure 5 *Nymphaea odorata* dominated the water surface in Ellen Lake

Figure 6: Lake Vegetation Index region map for Ellen Lake

Table 2: Lake Vegetation Index results for Ellen Lake 6/29/17

SPECIES	CofC	Region			
		1	4	7	10
Ceratopteris thalictroides	2.93	1	1	1	1
Ludwigia peruviana	**0**	**1**	**1**	**1**	**1**
Melaleuca quinquenervia	**0**	**1**	**1**	**1**	**1**
Mikania scandens	1.95	1	1	1	1
Oxycaryum cubense	**0.5**	**C**	**1**	**1**	**D**
Typha	1	C	1	1	1
Utricularia gibba	6.37	1	1	1	1
Alternanthera philoxeroides	**0**	**1**		**1**	**1**
Eupatorium capillifolium	0.83		1	1	1
Nymphaea odorata	5		D	D	1
Quercus laurifolia	4	1	1		1
Salix caroliniana	2.95	1	1	1	
Salvinia minima	**0**	**1**		**1**	**1**
Colocasia esculenta	**0**	**1**			**1**
Cyperus odoratus	3		1		1
Quercus nigra	2.5			1	1
Schinus terebinthifolius	**0**	**1**		**1**	
Sphagneticola trilobata	**0**			**1**	**1**
Acer rubrum	4.65			1	
Blechnum serrulatum	5.5			1	
Cephalanthus occidentalis	5			1	
Habenaria repens	3.5			1	
Ipomoea indica	1.23				1
Polygonum glabrum	4.5		1		
Sesbania herbacea	1				1
Taxodium	7		1		
Xyris jupicai	3.51			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	14	20	18
% Native taxa in sampling unit	38.46154	71.42857	60	55.55556
% FLEPPC CAT 1 taxa in sampling unit	38.46154	14.28571	20	22.22222
% Sensitive taxa in sample unit	0	7.142857	0	0
Dominant CoC in sample unit	0.75	5	5	0.5
Native Score ((x-62.5)/37.5) or ((x-66.67)/25.89)=	0	0.1838	0	0
Invasive FLEPPC 1 Score (1 - (x/30))=	0	0.52381	0.333333	0.259259
Sensitive Score (x/(27.78 or 20)) =	0	0.357143	0	0
Dominant CoC Score (x/(7.91 or 7)) =	0.107143	0.714286	0.714286	0.071429
Raw Score Total = N+I+S+D =	0.107143	1.779038	1.047619	0.330688
Division Factor = (3 D=0 or 4) =	4	4	4	4
Average LVI dividend = Raw /DF	0.026786	0.444759	0.261905	0.082672
SOUTH				
LVI Score for sampling unit =	2.678571	44.47594	26.19048	8.267196

Total LVI SCORE = 20

Water Quality Assessment

Limited long-term water quality data is available for Ellen Lake. The majority of the available data was collected by Florida Department of Environmental Protection and Southwest Florida Water Management District between 2000 and 2012. Table 4 provides a summary of the Physical/Chemical conditions recorded at the middle of Ellen Lake.

Table 4: Ellen Lake Water Quality (Field)

Depth (m)	Temp °C	pH	DO (mg/L)	DO (%sat)	Cond (unho/cm)	Salinity (ppt)	TDS (mg/L)	Secchi Depth (m)
0.4	29.99	7.65	1.79	22.9	134.5	0.06	86.1	1.8
0.52	29.87	6.91	2.52	32.3	134.6	0.06	86.1	
2.12	28.82	7.29	0	0	135.9	0.06	86.9	
3.97	25.2	7.42	0	0	158.5	0.07	101.4	
POR	20.33	6.62	3.18		177.4	0.03		

The chemical water quality analysis for Ellen Lake is shown in Table 5 for the sample taken on June 29, 2017. 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. Total Phosphorous values were below the nutrient threshold for clear alkaline lakes with insufficient data developed by FDEP of 0.03 mg/l with a value of 0.014 mg/l for the POR and above the threshold for the single sample with a value of 0.044 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 0.681 mg/l for the POR data and 0.344 for the most recent data. Chlorophyll-a values are below the nutrient threshold for clear alkaline lakes developed by FDEP of 20.0 µg/l with a value of 3.82 µg/l for the POR and 3.5 µg/l for the most recent sample.

Bacteria testing showed low levels of Fecal Coliform (10 colonies/100ml) and Enterococci (10 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: Ellen Lake Water Quality Results from 6/29/2017 (Laboratory)

Parameter	Ellen Lake (Center)	POR Mean Value	Units
Alkalinity	45.0		mg/LCaCO3
Nitrates/Nitrites	0.005		mg/L
Fecal Coliform	10	20	#/100 ml
Enterococci	10		#/100 ml
Chlorophyll a	4.3	5.34	ug/L
Chlorophyll b	2.6	1.15	ug/L
Chlorophyll c	0.5	1.51	ug/L
Chlorophyll t	5.4		ug/L
Chlorophylla Corr	3.5	3.82	ug/L
Chlorophyll-pheo	6.6		ug/L
Ammonia	0.006	0.023	mg/L
Kjeldahl Nitrogen	0.339	0.340	mg/L
Total Nitrogen	0.344	0.681	mg/L
Total Phosphorus	0.044	0.014	mg/L
Color(345)F.45	21.4	32.65	Pt/Co

Table 6: Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	32.65
Number of Samples	8
Geometric Mean Alkalinity (mg/L CACO3)	45.0
Number of Samples	1
Lake Type	Clear Alkaline
Chlorophyll a Criteria (ug/L)	20
Insufficient for Geomean Criteria then P mg/L	0.03
Insuffcient for Geomean Criteria then N mg/L	1.05
Geomean Chla ug/L	3.82
Geomean TP mg/L	0.014
Geomean TN mg/L	0.681
Number of Samples	7
Potential Impaired Chlorophyll a	Not Impaired
Potential Impaired TP	Not Impaired
Potential Impaired TN	Not Impaired

Conclusion

The results of the assessment of Ellen Lake shows a healthy lake based on Total Nitrogen, Total Phosphorous and Chlorophyll concentrations compared to the FDEP numeric nutrient criteria using the limited long term water quality record. 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. The system shows impairment in the vegetation communities according to the Lake Vegetation Index with low overall species (27), high occurrences of non-native, invasive species and dominance by pest plant species with an overall LVI score of 20. The assessment revealed a limited submerged aquatic vegetation community occupying 6.3% of the surface area and 0.1% of the volume of Ellen Lake.