Mango Lake

Methods

Study Area Analysis

The watershed containing Mango 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 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

Mango Lake is located south of Broadway Ave between Lakewood Drive and Highview Road near Brandon, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Mango Lake is dominated by Residential (64.04%), Reservoirs (10.16%) and Natural (23.72%) land uses. The resulting LDI value for the 100 meter buffer around Mango Lake is 5.95. The LDI value calculated for the FDEP WBID containing Mango Lake was 6.51 with approximately 49.4% of the land use being Residential, 15.7% Commercial and Services, 6.8% Industrial/ Institutional and 9.3% Agricultural.

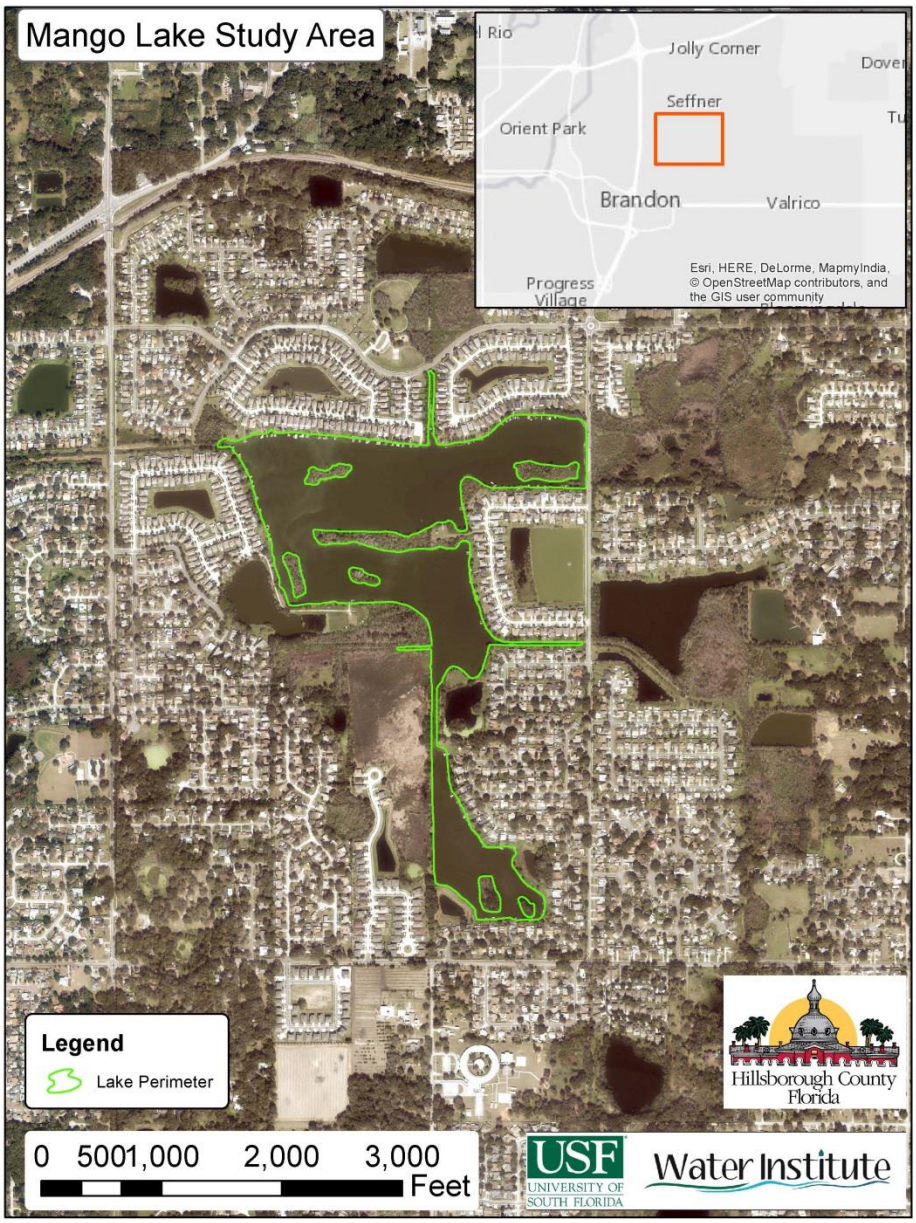

Figure 1 2016 Mango Lake Assessment Study Area Map

Lake Bathymetry and Morphological Characterization

Mango Lake is a heavily altered, created lake in an urban setting. At the time of the assessment, Mango Lake was experiencing moderately high water levels resulting in a 78.9 acre water body. Mango Lake at the time of the assessment had a mean water depth of 5.7 feet and a maximum observed depth of 12.7 feet. The volume at this time was approximately 146,619,681 gallons. Figure 2 shows the resulting bathymetric contour map for Mango Lake from data collected on July 20, 2016. The collected data has been overlain the 2014 Hillsborough County aerials.

Figure 2 2016 1-Foot Bathymetric Contour Map for Mango Lake

Table 1 Morphological Calculations for Mango Lake

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	3,438,424	319,437	78.9	0	0
Mean Depth	5.7	1.74	0	0	0
Maximum Depth	12.7	3.87	0	0	0
Volume (cubic)	19,600,065	555,007	0	450.0	146,619,681
Gauge (relative)	NA	NA	0	0	0

Lake Vegetation Index Assessment

Figure 3 Overview photograph of Mango Lake

The lake assessment for Mango Lake was conducted on July 20, 2016. Mango Lake received a lake habitat assessment (FEDP form FD 9000-6) score of 64 due to suboptimal scores for Bottom Substrate Quality and Adverse Watershed Land Use. Marginal scores were achieved for Vegetation Quality, Stormwater Inputs, Lakeside Adverse Human Alterations and Upland Buffer Zone. Secchi received poor scores.

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

The Lake Vegetation Index identified 51 species of wetland vegetation growing in the four selected sections along Mango Lake. The majority of these species (35) are native species. The remaining 16 species (Shown in Bold in Table 2) are non-native and invasive to this region. The vegetation community along Mango Lake is dominated by a variety of emergent species including *Typha, Panicum repens* and *Colocasia esculenta* (Figure 5). The water's surface in Mango Lake was dominated by *Pistia stratiotes* and *Eicchornia crassipes* (Figure 6). The calculated LVI score for Mango Lake was 14, below the impairment threshold of 37. Figure 7 shows the map of Mango 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. Submerged vegetation was observed during the assessment and was dominated by *Hydrilla verticillata*. By analyzing the collected sonar chart, submerged aquatic vegetation covered approximately 6% of the surface area of Mango Lake. This submerged vegetation inhabits an estimated 1.3% of the water volume in Mango Lake.

Figure 5 *Panicum repens* and *Typha* on Mango Lake

Figure 6 *Eicchornia crassipes* on Mango Lake

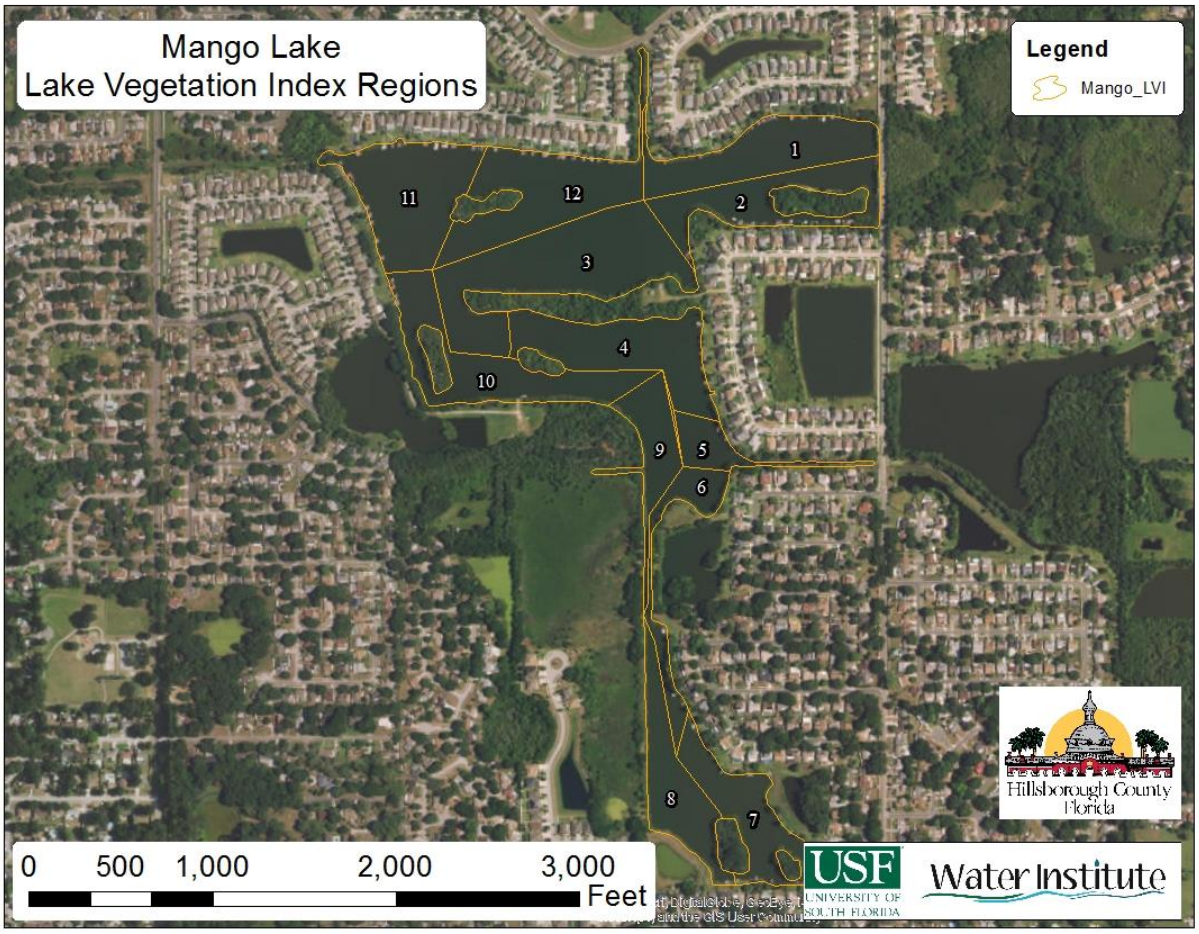

Figure 7 Lake Vegetation Index region map for Mango Lake

Table 2 Lake Vegetation Index results for Mango Lake 7/20/2016

SPECIES	Region				
	CofC	2	5	8	11
Alternanthera philoxeroides	0.00	1	1	1	1
Colocasia esculenta	0.00	1	1	1	1
Hydrilla verticillata	0.00	1	1	1	1
Hydrocotyle	2.00	1	1	1	1
Ludwigia leptocarpa	3.00	1	1	1	1
Panicum repens	0.00	1	C	1	1
Pistia stratiotes	0.00	1	1	1	1
Typha	1.00	C	1	D	1
Boehmeria cylindrica	5.00	1		1	1
Eichhornia crassipes	0.00	C		1	C
Mikania scandens	1.95		1	1	1
Myrica cerifera	2.00	1		1	1
Salix caroliniana	2.95	1		1	1
Sapium sebiferum	0.00	1		1	1
Taxodium	7.00	1		1	1
Urochloa mutica	0.00	1	1		1
Bacopa monnieri	3.50	1		1	
Cyperus alternifolius	0.00	1			1
Cyperus distinctus	5.00		1		1
Eupatorium capillifolium	0.83	1		1	
Ludwigia peruviana	0.00	1			1
Panicum hemitomon	5.82	1		1	
Pluchea baccharis	5.45		1	1	
Polygonum glabrum	4.50	1		1	
Pontederia cordata	5.38	1			C
Sagittaria lancifolia	3.00	1			1
Salvinia minima	0.00		1	1	
Schinus terebinthifolius	0.00	1		1	
Sesbania herbacea	1.00	1			1
Vallisneria americana	7.00			1	1
Baccharis		1			
Blechnum serrulatum	5.50				1
Canna flaccida	5.50		1		
Commelina diffusa	2.02		1		
Hydrolea quadrivalvis	2.00			1	
Hygrophila polysperma	0.00		C		
Juncus effusus	2.00			1	
Juncus marginatus	1.50			1	
Lemna	1.00		1		
Magnolia virginiana	7.00			1	
Myriophyllum aquaticum	0.98		1		
Paspalum repens	5.60		1		
Polygonum hydropiperoides	2.50			1	
Quercus laurifolia	4.00			1	
Quercus nigra	2.50			1	
Rhexia cubensis	7.22			1	
Ruellia simplex	0.00				1
Sambucus nigra	1.48	1			
Schoenoplectus tabernaemontani	5.55	1			
Thalia geniculata	6.00	1			
Xyris jupicai	3.51			1	

Table 3 Scoring Summary for the Lake Vegetation Index

LVI Score Summary	Region			
	2	5	8	11
Total # of taxa in sampling unit	29	19	32	25
% Native taxa in sampling unit	62.06897	47.36842	71.875	56
% FLEPPC CAT 1 taxa in sampling unit	31.03448	36.84211	25	36
% Sensitive taxa in sample unit	3.448276	0	12.5	8
Dominant CoC in sample unit	0.5	0	1	2.69
Native Score ((x-62.5)/37.5) or ((x-66.67)/25.89)=	0	0	0.201043	0
Invasive FLEPPC 1 Score (1 - (x/30))=	0	0	0.166667	0
Sensitive Score (x/(27.78 or 20)) =	0.172414	0	0.625	0.4
Dominant CoC Score (x/(7.91 or 7)) =	0.071429	0	0.142857	0.384286
Raw Score Total = N+I+S+D =	0.243842	0	1.135567	0.784286
Division Factor = (3 D=0 or 4) =	4	4	4	4
Average LVI dividend = Raw /DF	0.060961	0	0.283892	0.196071
South				
LVI Score for sampling unit =	6.096059	0	28.38917	19.60714
Total LVI SCORE =	14			

Water Quality Assessment

Long-term water quality data is available for Mango Lake due to the efforts of LAKEWATCH volunteers. Additional data was collected as part of this lake assessment. Table 4 provides a summary of the Physical/Chemical conditions recorded at the middle of Mango Lake.

Table 4 Mango Lake Water Quality (Field)

Depth (m)	Temp (c)	pH	DO (mg/L)	DO (% Sat)	Cond (umho/cm)	Salinity (ppt)	TDS (mg/L)	Secchi Depth (m)
0.1	31.29	8.14	9.18	121.8	151.4	0.07	96.9	0.4
0.27	31	9.22	9.25	122	151.5	0.07	96.9	
2.06	30.53	6.35	1.07	14	152.4	0.07	97.5	
3.69	30.21	6.41	0	0	165.7	0.08	106.1	

The chemical water quality analysis for Mango Lake is shown in Table 5 for the sample taken on July 21, 2016. Table 6 includes this data in the numeric nutrient criteria framework using the data from this assessment and the LAKEWATCH dataset. Table 7 Summarizes the annual geometric mean values calculated for Total Phosphorous, Total Nitrogen and Chlorophyll-a. Total Phosphorous values were above the nutrient threshold for clear alkaline lakes with sufficient data developed by FDEP of 0.09 mg/l with a value of 0.151 mg/l. Total Nitrogen values were above the nutrient threshold for clear alkaline lakes with sufficient data developed by FDEP of 1.91 mg/l with a value of 1.974 mg/l. Chlorophyll-a values are above the nutrient threshold for clear alkaline lakes developed by FDEP of 20.0 µg/l with a value of 70 µg/l.

Bacteria testing showed moderate levels of Fecal Coliform (96 colonies/100ml) above the rules set forth in FDEP 62-302.530. Entercocci bacteria were in high abundance (660 colonies/ 100ml) (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 Mango Lake Water Quality Results from 7/21/2016(Laboratory)

Parameter	Value	Units
Alkalinity	32.0	mg/LCaCO3
Nitrates/Nitrites	0.003	mg/L
Fecal Coliform	96	#/100 ml
Enterococci	660	#/100 ml
Chlorophyll a	94.4	ug/L
Chlorophyll b	5.1	ug/L
Chlorophyll c	4.6	ug/L
Chlorophyll t	104.1	ug/L
Chlorophylla Corr	77.0	ug/L
Chlorophyll-pheo	24.4	ug/L
Ammonia	0.017	mg/L
Kjeldahl Nitrogen	1.971	mg/L
Total Nitrogen	1.974	mg/L
Total Phosphorus	0.151	mg/L
Color(345)F.45	34.1	Pt/Co

Table 6 Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	34.1
Number of Samples	1
Geometric Mean Alkalinity (mg/L CACO3)	32.0
Number of Samples	1
Lake Type	Clear Alkaline
Chlorophyll a Criteria (ug/L)	20
Sufficient for Geomean Criteria then P mg/L	0.09
Suffcient for Geomean Criteria then N mg/L	1.91
Three Year Geomean Chla ug/L	111.5
Three Year Geomean TP mg/L	0.161
Three Year Geomean TN mg/L	1.943
Number of Samples	14
Potential Impaired Chlorophyll a	Impaired
Potential Impaired TP	Impaired
Potential Impaired TN	Impaired

Table 7 Numeric Nutrient Criteria Annual Geometric Mean Values

Yearly Geomeans	Chlorophyll a (ug/L)	Total Phosphorous (mg/L)	Total Nitrogen (mg/L)	Number of Samples
2014	137.4	0.194	1.537	8
2015	110.4	0.166	2.301	4
2016	91.3	0.129	2.073	2
3-Year Geomean	111.5	0.161	1.943	14

Conclusion

The results of the assessment of Mango Lake shows impairment based on Total Nitrogen, Total Phosphorous and Chlorophyll concentrations according to the FDEP numeric nutrient criteria using the available LAKEWATCH data and the sample taken during this assessment. The system also shows impairment in the vegetation communities according to the Lake Vegetation Index with high overall species, high occurrences of non-native, invasive species and few sensitive plant species with an overall LVI score of 14. Bacteria sampling also revealed elevated biomass of Entercocci bacteria present at the time of the assessment.