

Lake Magdalene

Methods

Study Area Analysis

The watershed containing Lake Magdalene 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 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 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 Magdalene is located between Bearss Ave and Fletcher Ave East of Dale Mabry Highway near Carrollwood, Florida. The Landscape Development Intensity Index of the 100 meter buffer around Lake Magdalene is dominated by Residential (85.3%), Transportation (2.2%) and Natural (10.4%) land uses. The resulting LDI value for the 100 meter buffer around Mango Lake is 7.14. The LDI value calculated for the FDEP WBID containing Mango Lake was 6.82 with approximately 51.9% of the land use being Residential, 10.8% Commercial and Services, 2.2% Institutional and 3.7% Transportation and Utilities.

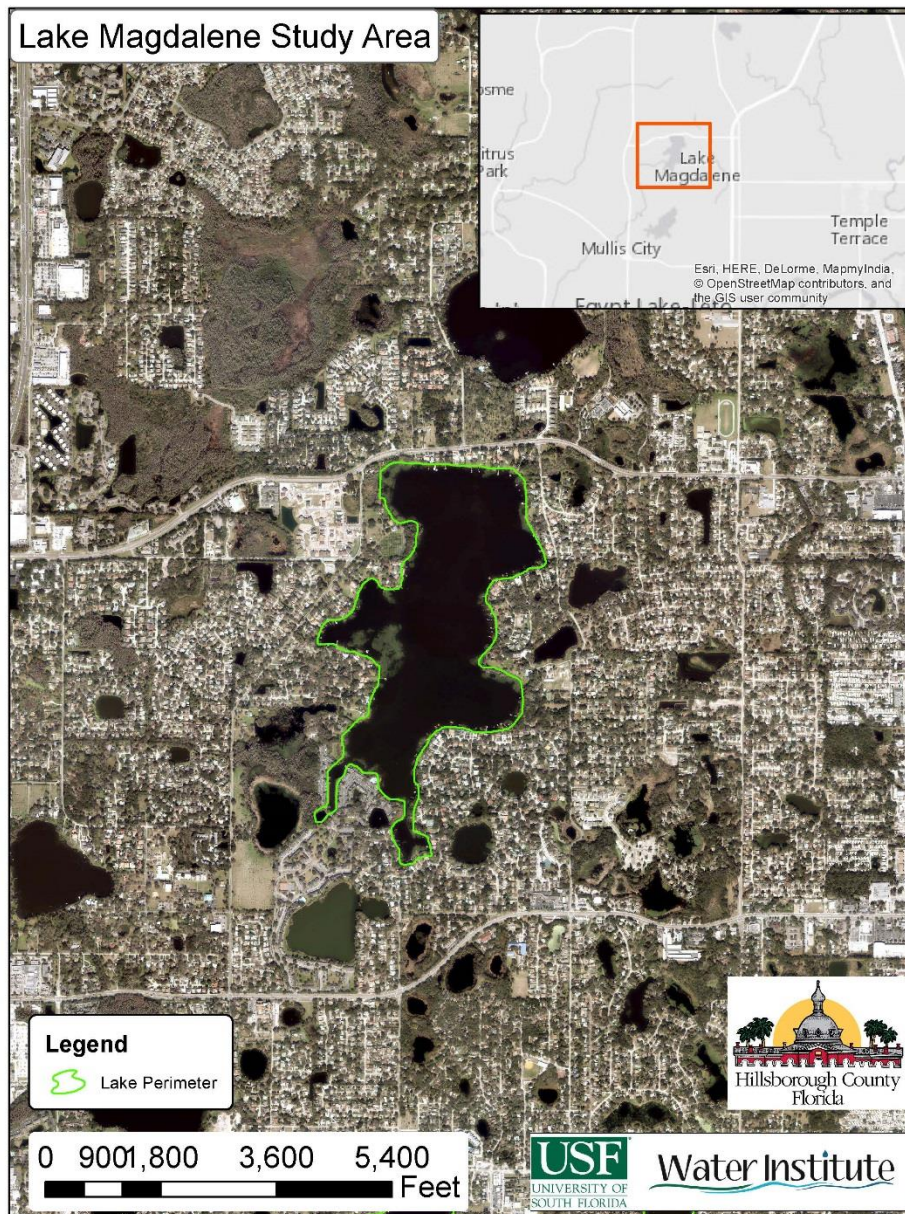


Figure 1 2016 Lake Magdalene Assessment Study Area Map

Lake Bathymetry and Morphological Characterization

Lake Magdalene is a fairly large lake in an urban setting. At the time of the assessment, Lake Magdalene was experiencing moderately high water levels resulting in a 242 acre water body. Lake Magdalene at the time of the assessment had a mean water depth of 8.1 feet and a maximum observed depth of 23.1 feet. The volume at this time was approximately 635,042,875 gallons. Figure 2 shows the resulting bathymetric contour map for Lake Magdalene from data collected on July 26, 2016. The collected data has been overlain the 2014 Hillsborough County aerals.

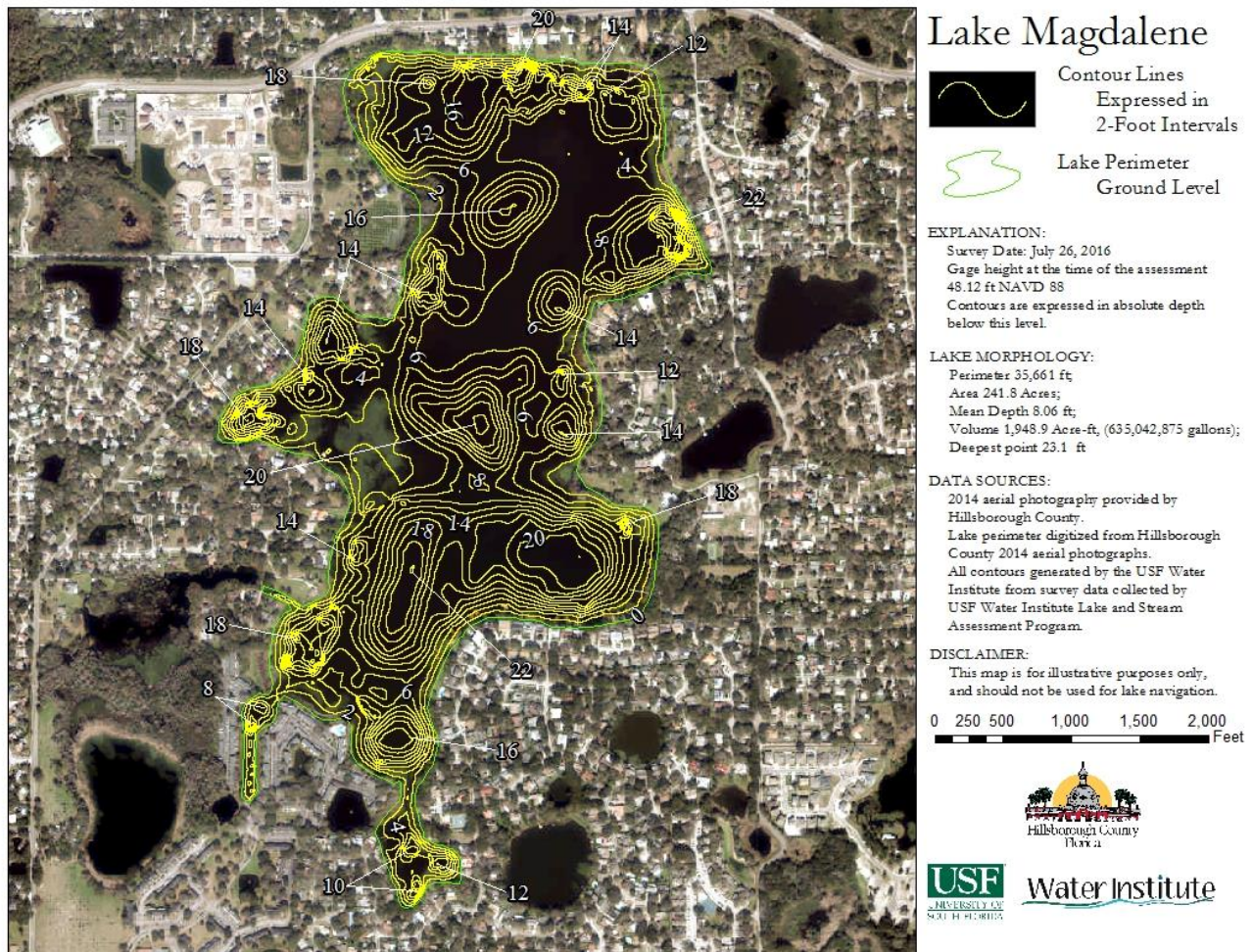


Figure 2 2016 2-Foot Bathymetric Contour Map for Lake Magdalene

Table 1 Morphological Calculations for Lake Magdalene

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	10,531,141	978,367	241.8	0	0
Mean Depth	8.06	2.46	0	0	0
Maximum Depth	23.1	7.04	0	0	0
Volume (cubic)	84,892,296	2,403,859	0	1,949	635,042,875
Gauge (NAVD 88)	48.12	14.67	0	0	0

Lake Vegetation Index Assessment



Figure 3 Overview photograph of Lake Magdalene

The lake assessment for Lake Magdalene was conducted on July 26, 2016. Lake Magdalene received a lake habitat assessment (FEDP form FD 9000-6) score of 74 due to suboptimal scores for Secchi, Vegetation Quality, Bottom Substrate Quality and Adverse Watershed Land Use. Marginal scores were achieved for Stormwater Inputs, Lakeside Adverse Human Alterations and Upland Buffer Zone.



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

The Lake Vegetation Index identified 57 species of wetland vegetation growing in the four selected sections along Lake Magdalene. The majority of these species (43) are native species. The remaining 14 species (Shown in Bold in Table 2) are non-native and invasive to this region. The vegetation community along Lake Magdalene is dominated by a variety of emergent species including *Typha*, *Panicum repens* and *Melaleuca quinquenervia* (Figure 5). The water's surface in Lake Magdalene was dominated by *Nymphaea odorata* (Figure 6) and *Nuphar*. The calculated LVI score for Lake Magdalene was 50, above the impairment threshold of 37. Figure 7 shows the map of Lake Magdalene 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 abundant during the assessment and was dominated by *Vallisneria Americana*, *Utricularia radiata* and *Utricularia foliosa*. By analyzing the collected sonar chart, submerged aquatic vegetation covered approximately 52% of the surface area of Lake Magdalene. This submerged vegetation inhabits an estimated 14.3% of the water volume in Mango Lake.



Figure 5 *Melaleuca quinquenervia* on Lake Magdalene



Figure 6 *Nymphaea odorata* on Lake Magdalene

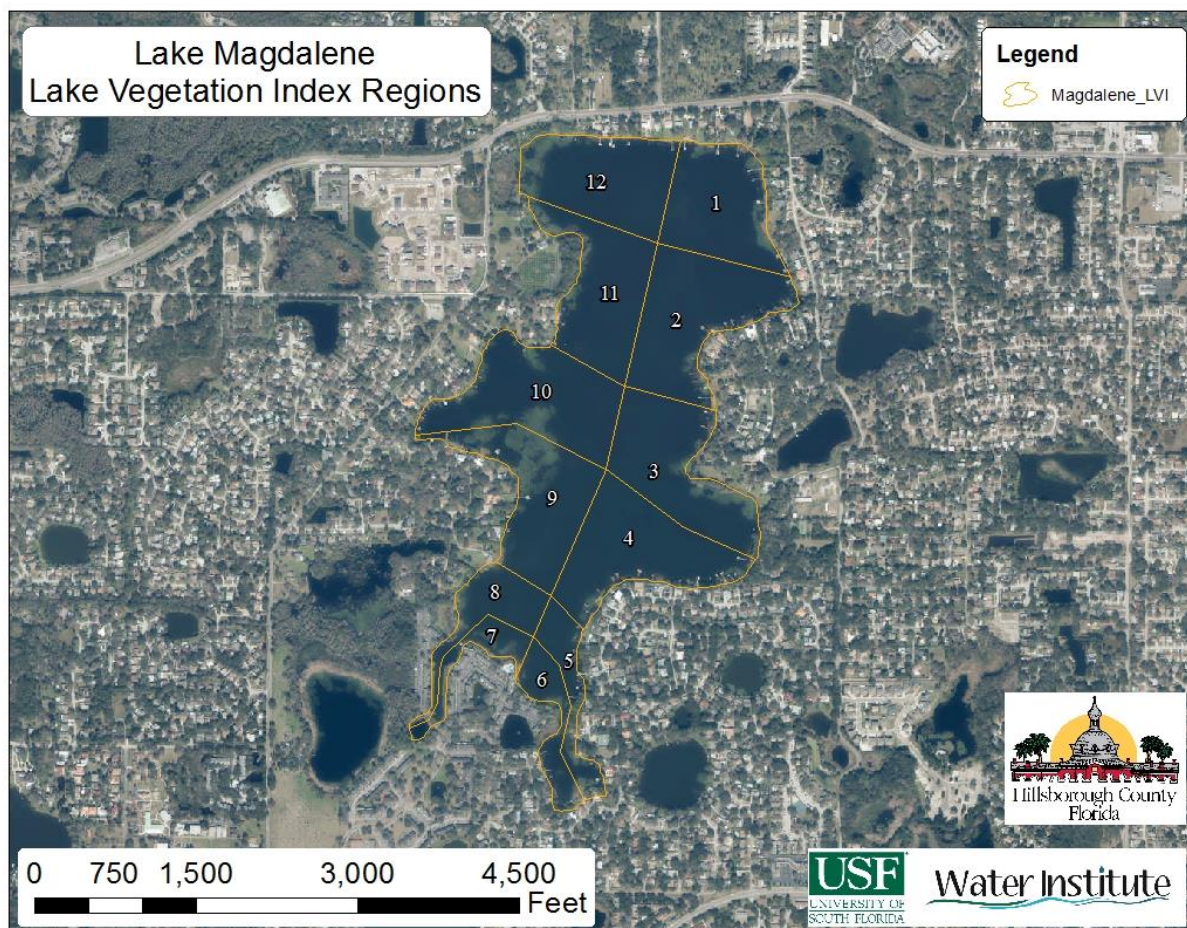


Figure 7 Lake Vegetation Index region map for Lake Magdalene

Table 2 Lake Vegetation Index results for Lake Magdalene 7/26/2016

SPECIES	Region				
	CofC	3	6	9	12
Alternanthera philoxeroides	0.00	1	1	1	1
Bacopa monnieri	3.50	1	1	1	1
Boehmeria cylindrica	5.00	1	1	1	1
Hydrocotyle	2.00	1	1	1	1
Ludwigia peruviana	0.00	1	1	1	1
Melaleuca quinquenervia	0.00	1	1	1	1
Najas guadalupensis	5.07	1	1	1	1
Nuphar	3.50	1	1	1	C
Nymphaea odorata	5.00	C	C	C	C
Panicum repens	0.00	1	1	1	1
Pontederia cordata	5.38	1	1	1	1
Sagittaria lancifolia	3.00	1	1	1	1
Sphagneticola trilobata	0.00	1	1	1	1
Typha	1.00	1	1	1	1
Utricularia foliosa	5.00	1	C	C	1
Utricularia radiata	6.01	1	1	1	1
Vallisneria americana	7.00	C	1	1	1
Bacopa caroliniana	4.50	1		1	1
Blechnum serrulatum	5.50	1	1		1
Cephalanthus occidentalis	5.00	1	1		1
Echinochloa walteri	2.50		1	1	1
Eleocharis interstincta	7.80	1	1		1
Mikania scandens	1.95	1		1	1
Myrica cerifera	2.00	1	1	1	
Salix caroliniana	2.95	1		1	1
Taxodium	7.00		1	1	1
Acer rubrum	4.65		1		1
Colocasia esculenta	0.00			1	1
Cyperus odoratus	3.00	1		1	
Eichhornia crassipes	0.00		1		1
Ludwigia arcuata	3.50		1		1
Ludwigia octovalvis	2.00	1		1	
Nitella	6.00		1	1	
Nymphoides aquatica	6.09		1	1	
Oxycaryum cubense	0.50		1		1
Pluchea baccharis	5.45	1			1
Quercus laurifolia	4.00			1	1
Sapium sebiferum	0.00	1	1		
Sesbania herbacea	1.00	1		1	
Utricularia gibba	6.37		1		1
Casuarina equisetifolia	0.00				1
Cyperus alternifolius	0.00			1	
Cyperus polystachyos	1.56		1		
Diodia virginiana	3.00			1	
Eclipta prostrata	2.00				1

Eupatorium capillifolium	0.83	1			
Ilex cassine	6.00	1			
Iris virginica	5.50	1			
Linnophila sessiliflora	0.00		1		
Liquidambar styraciflua	2.50		1		
Ludwigia linearis	5.72		1		
Magnolia virginiana	7.00				1
Micranthemum glomeratum	5.85		1		
Osmunda cinnamomea	6.44				1
Salvinia minima	0.00		1		
Schinus terebinthifolius	0.00			1	
Schoenoplectus pungens	4.00		1		

Table 3 Scoring Summary for the Lake Vegetation Index

LVI Score Summary	Region			
	3	6	9	12
Total # of taxa in sampling unit	32	38	33	37
% Native taxa in sampling unit	81.25	73.68421	75.75758	75.67568
% FLEPPC CAT 1 taxa in sampling unit	12.5	15.78947	15.15152	16.21622
% Sensitive taxa in sample unit	6.25	7.894737	6.060606	10.81081
Dominant CoC in sample unit	6	5	5	4.25
Native Score ((x-62.5)/37.5) or ((x-66.67)/25.89)=	0.563152	0.270924	0.351007	0.347844
Invasive FLEPPC 1 Score (1 - (x/30))=	0.583333	0.473684	0.494949	0.459459
Sensitive Score (x/(27.78 or 20)) =	0.3125	0.394737	0.30303	0.540541
Dominant CoC Score (x/(7.91 or 7)) =	0.857143	0.714286	0.714286	0.607143
Raw Score Total = N+I+S+D =	2.316128	1.85363	1.863273	1.954987
Division Factor = (3 D=0 or 4) =	4	4	4	4
Average LVI dividend = Raw /DF	0.579032	0.463408	0.465818	0.488747
South				
LVI Score for sampling unit =	57.9032	46.34076	46.58182	48.87467
Total LVI SCORE =	50			

Water Quality Assessment

Long-term water quality data is available for Lake Magdalene 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 low levels of Fecal Coliform (20 colonies/100ml) above the rules set forth in FDEP 62-302.530. Enterococci bacteria were also in low abundance (10 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 Lake Magdalene Water Quality Results from 7/28/2016(Laboratory)

Parameter	Value	Units
Alkalinity	38.0	mg/LCaCO ₃
Nitrates/Nitrites	0.003	mg/L
Fecal Coliform	20	#/100 ml
Enterococci	10	#/100 ml
Chlorophyll a	6.7	ug/L
Chlorophyll b	2.6	ug/L
Chlorophyll c	1.4	ug/L
Chlorophyll t	8.9	ug/L
Chlorophylla Corr	5.8	ug/L
Chlorophyll-pheo	6.6	ug/L
Ammonia	0.007	mg/L
Kjeldahl Nitrogen	0.744	mg/L
Total Nitrogen	0.747	mg/L
Total Phosphorus	0.012	mg/L
Color(345)F.45	10.5	Pt/Co

Table 6 Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	10.5
Number of Samples	1
Geometric Mean Alkalinity (mg/L CaCO ₃)	38.0
Number of Samples	1
Lake Type	Clear Alkaline
Chlorophyll a Criteria (ug/L)	20
Sufficient for Geomean Criteria then P mg/L	0.09
Sufficient for Geomean Criteria then N mg/L	1.91
Three Year Geomean Chla ug/L	6.23
Three Year Geomean TP mg/L	0.015
Three Year Geomean TN mg/L	0.733
Number of Samples	31
Potential Impaired Chlorophyll a	Not Impaired
Potential Impaired TP	Not Impaired
Potential Impaired TN	Not 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	5.41	0.013	0.649	12
2015	7.15	0.016	0.768	14
2016	6.26	0.017	0.790	4
3-Year Geomean	6.23	0.015	0.733	31

Conclusion

The results of the assessment of Lake Magdalene does not show 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 healthy vegetation communities according to the Lake Vegetation Index with high overall species, moderate occurrences of non-native, invasive species and several sensitive plant species with an overall LVI score of 50. Bacteria sampling revealed low biomass of Fecal Coliform and Enterococci bacteria present at the time of the assessment.