



Lake Grady

LAKE HABITAT ASSESSMENT, LAKE VEGETATION INDEX, SUBMERGED
VEGETATION SURVEY AND WATER QUALITY

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Methods

STUDY AREA ANALYSIS

The watershed containing the Lake Grady was analyzed using ESRI ArcGIS 10.6. Using this software with 2017 Hillsborough County aerial, 2014 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 one. In the Florida framework, the maximum LDI index score is approximately 42."

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. 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 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.

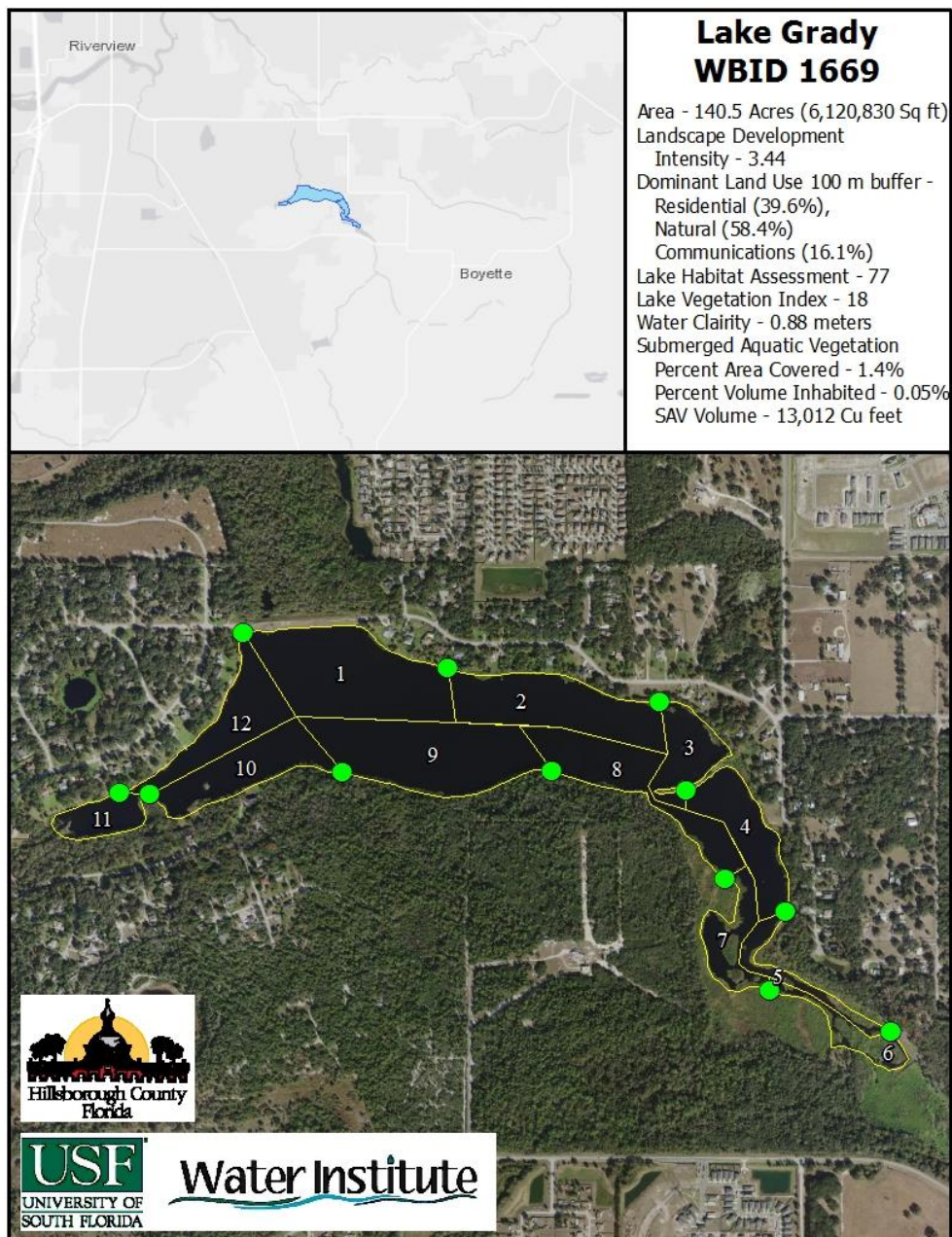
WATER QUALITY ASSESSMENT

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, 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 Grady is located in east-central Hillsborough County, Florida. Lake Grady is an impoundment of Bell Creek and Pelleham Creek. Bell Creek continues flowing north out of the control structure on the northern shore. The Landscape Development Intensity Index of the 100 meter buffer around Lake Grady is dominated by Natural (58.4%), Residential (39.6%) and Communications (16.1%) land uses. The resulting LDI value for the 100 meter buffer around Lake Grady is 3.44.

FIGURE 1: 2019 LAKE GRADY ASSESSMENT STUDY AREA MAP



Lake Bathymetry and Morphological Characterization

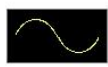
At the time of the assessment, Lake Grady was experiencing elevated water levels with a water elevation of 34.86 ft NAVD 88 resulting in a 140.5 acre water body. Lake Grady at the time of the assessment had a mean water depth of 4.48 feet and a maximum observed depth of 12.66 feet. The volume at this time was approximately 205,059,066 gallons. Figure 2 shows the resulting bathymetric contour map for Lake Grady from data collected on May 17, 2019. The collected data has been overlain the 2017 Hillsborough County aerials.

Table 1: Morphological Calculations for Lake Grady

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	6,120,830	568,639	140.5		
Mean Depth	4.48	1.37			
Maximum Depth	12.66	3.86			
Volume (cubic)	27,412,220	776,220		629.3	205,059,066
Gauge (NAVD 88)	34.55	10.63			

Figure 2: 2019 1-Foot Bathymetric Contour Map for Lake Grady

Grady Lake WBID 1669



Contour Lines
Expressed in
1-Foot Intervals



Lake Perimeter
Ground Level

LAKE MORPHOLOGY:

Perimeter 22,356 ft;
Area 140.5 Acres;
Mean Depth 4.48 ft;
Volume 629.3 Acre-ft (205,059,066 gallons);
Deepest point 12.66 ft

0 390 780 1,560 Feet

EXPLANATION:

Survey Date: May 17, 2019
Water level was 34.55 ft NAVD 88
at the time of the assessment.
Contours are expressed in absolute depth
below this level.

DISCLAIMER:

This map is for illustrative purposes only,
and should not be used for lake navigation.



Water Institute

DATASOURCES:

2017 aerial photography provided by
Hillsborough County.
Lake perimeter digitized from Hillsborough
County 2017 aerial photographs.
All contours generated by the USF Water
Institute from survey data collected by
USF Water Institute Lake and Stream
Assessment Program.

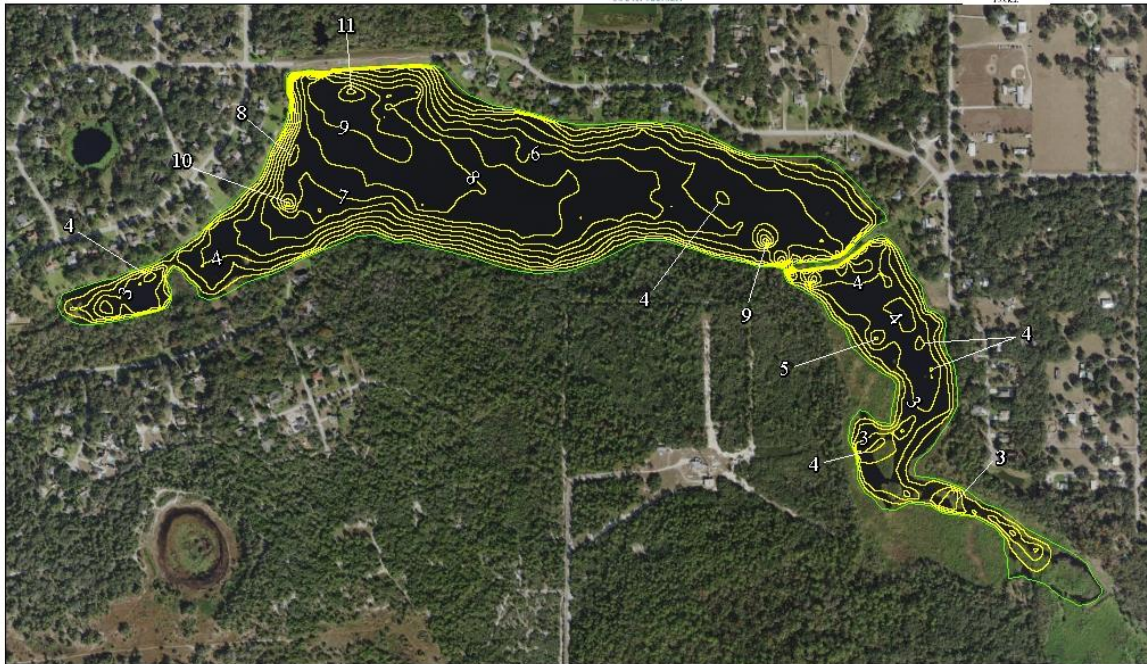


Figure 3 Overview photograph of Lake Grady showing typical shoreline vegetation in an undeveloped area.



Lake Habitat and Lake Vegetation Index Assessment

The lake assessment for Lake Grady was conducted on May 17, 2019. Lake Grady received a lake habitat assessment (FEDP form FD 9000-6) score of 77 due to suboptimal scores for Vegetation Quality, Lakeside Adverse Human Alterations, Upland Buffer Zone and Adverse Watershed Land Use. Secchi, Stormwater Inputs and Bottom Substrate Quality received Marginal scores.

The water in Lake Grady was characterized as a clear water system with high phytoplankton biomass with a color value of 16.8 PCU and a chlorophyll-a corrected value of 108.1 µg/l. The secchi disk depth was 0.88 meters in part due to the high biomass of phytoplankton and turbidity. The vegetation quality of the plants in and buffering Lake Grady are predominantly native species with moderate growths of non-native nuisance species such as *Panicum repens*, *Ludwigia peruviana*, *Alternanthera philoxeroides*, *Pistia stratiotes*, *Urochloa mutica*, *Myriophyllum aquaticum*, *Salvinia minima*, *Colocasia esculenta*, *Aeschynomene inidca*, *Hygrophila polysperma*,

Panicum maximum, *Sphagneticola trilobata* and *Eichhornia crassipes*. Some direct inputs of stormwater were noted through pipes and ditches to the lake, but most stormwater reaches the lake via sheet flow. Due to the impounded nature of Lake Grady, bottom substrate quality was dominated by coarse particulate organic matter near shore and some accumulation of muck. Approximately 39.6% of the surrounding land has been developed for residential housing. The majority of homeowners have not maintained a vegetated buffer zone along the shoreline.

Figure 4 Typical vegetation community along a vegetated section of Lake Grady shoreline.



The Lake Vegetation Index identified 61 species of wetland vegetation growing in the four selected sections along Lake Grady. The majority of these species (48) are native species. The remaining 13 species (*Panicum repens*, *Ludwigia peruviana*, *Alternanthera philoxeroides*, *Pistia stratiotes*, *Urochloa mutica*, *Myriophyllum aquaticum*, *Salvinia minima*, *Colocasia esculenta*, *Aeschynomene inidca*, *Hygrophila polysperma*, *Panicum maximum*, *Sphagneticola trilobata* and *Eichhornia crassipes*) are non-native and invasive to this region. The vegetation community along Lake Grady is dominated by a variety of emergent species including *Acer rubrum*, *Cephalanthus occidentalis*, *Ludwigia peruviana* and *Panicum repens*. The water's surface in Lake Grady was

dominated by *Eichhornia crasipes* and *Pistia stratiodes*. Four species of submerged aquatic vegetation were observed in the lake. The extent of submerged vegetation was limited due to the low water visibility and phytoplankton blocking available light. By analyzing the collected sonar chart, submerged aquatic vegetation covered approximately 1.4% of the lakes surface area and 0.05% of the lakes volume. Figure 5 shows the results of the SAV analysis indicating the location and height of SAV.

The calculated LVI score for Lake Grady was 18, below the impairment threshold of 37 indicating that the vegetation community is “Impaired” based on the species present and dominance. Figure 6 shows the map of Lake Grady detailing the LVI regions used for the assessment (Regions 2, 5, 8, 11). Table 2 details the species list results of the Lake Vegetation Index. Table 3 details the scoring result for the Lake Vegetation Index.

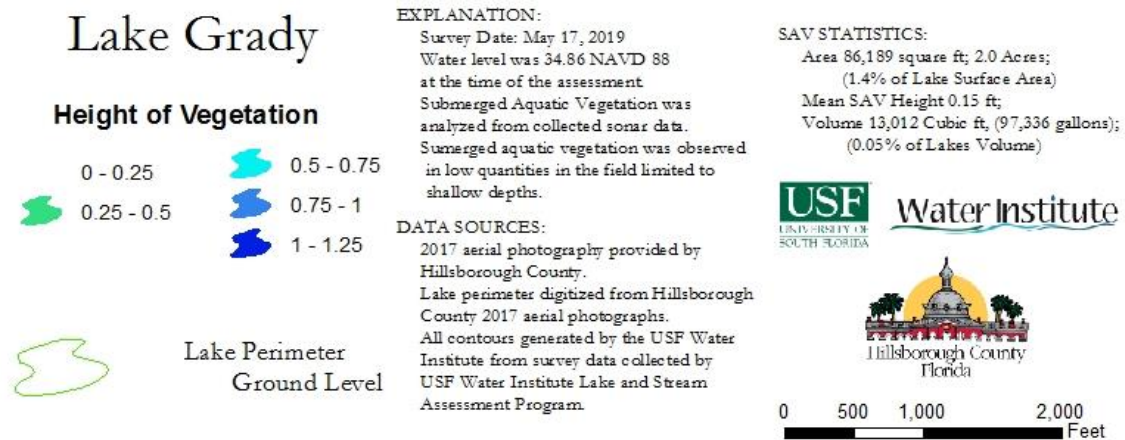


Figure 5 Lake Grady Submerged Aquatic Vegetation Assessment Results

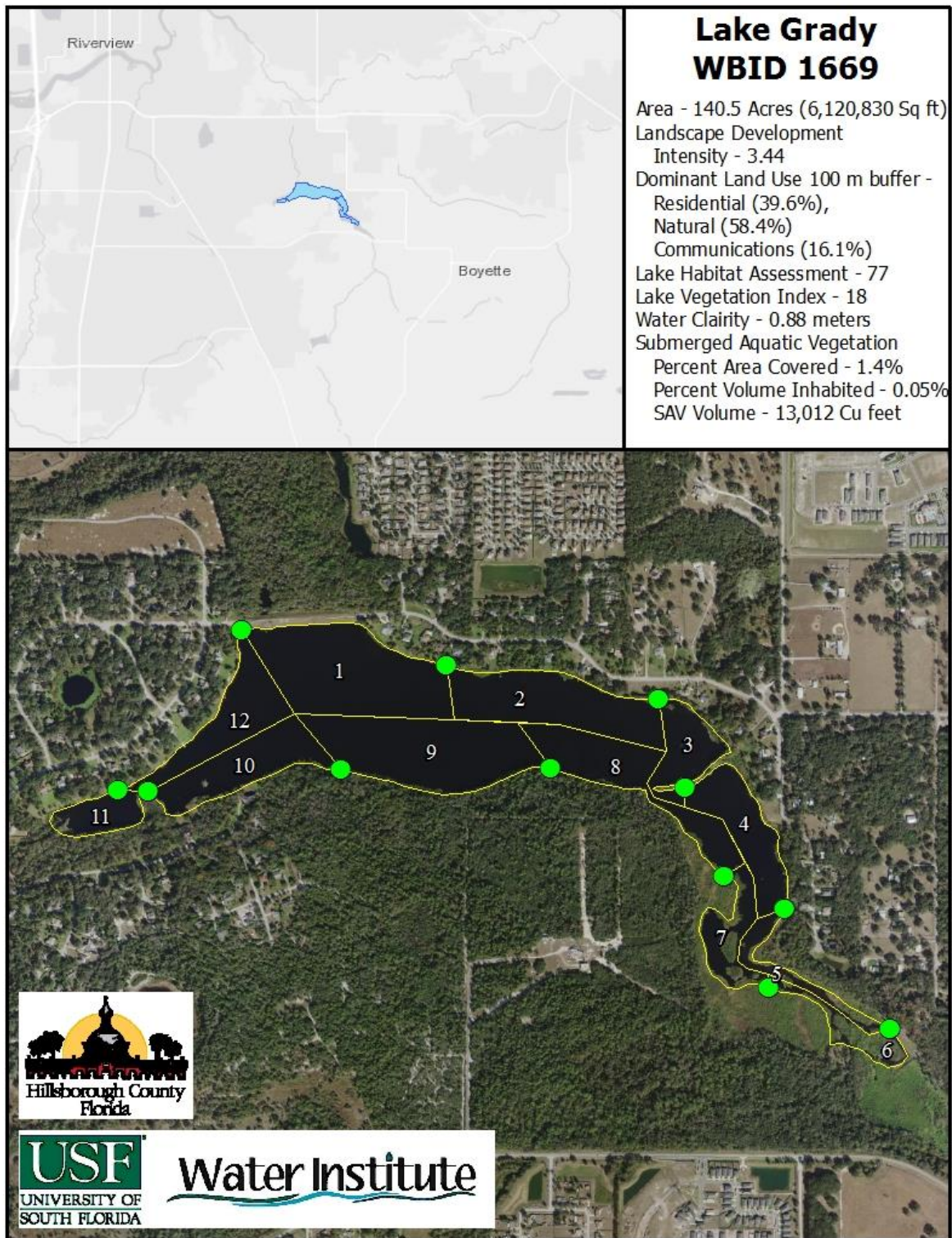


Figure 6: Lake Vegetation Index region map for Lake Grady

Table 2: Lake Vegetation Index results for Lake Grady May 17, 2019

SPECIES	CofC	Region			
		2	5	8	11
Acer rubrum	4.65	1	1	1	1
Alternanthera philoxeroides	0.00	1	1	1	1
Cephalanthus occidentalis	5.00	1	1	1	1
Cicuta maculata	4.54	1	1	1	1
Eichhornia crassipes	0.00	1	1	1	1
Eleocharis baldwinii	2.82	1	1	1	1
Ludwigia peruviana	0.00	1	C	1	1
Mikania scandens	1.95	1	1	1	1
Myrica cerifera	2.00	1	1	1	1
Myriophyllum aquaticum	0.98	1	1	1	1
Pistia stratiotes	0.00	C	1	1	1
Salvinia minima	0.00	1	1	1	1
Urochloa mutica	0.00	1	1	C	C
Boehmeria cylindrica	5.00	1		1	1
Colocasia esculenta	0.00	1		1	1
Cyperus odoratus	3.00	1	1		1
Hydrocotyle	2.00	1	1	1	
Liquidambar styraciflua	2.50	1		1	1
Ludwigia leptocarpa	3.00		1	1	1
Panicum repens	0.00	C		1	C
Polygonum hydropiperoides	2.50	1		1	1
Ptilimnium capillaceum	2.73		1	1	1
Salix caroliniana	2.95	1	C	1	
Typha	1.00	1	1	1	
Oxycaryum cubense	0.50	1	1	C	
Baccharis		1		1	
Diodia virginiana	3.00			1	1
Eclipta prostrata	2.00			1	1
Lemna	1.00	1			1
Luziola fluitans	4.00	1	1		
Micranthemum umbrosum	5.66		1		1
Osmunda cinnamomea	6.44		1	1	
Pluchea baccharis	5.45	1			1
Quercus laurifolia	4.00			1	1
Quercus nigra	2.50			1	1
Taxodium	7.00	1			1
Aeschynomene indica	0.49		1		
Azolla caroliniana	1.81		1		
Centella asiatica	1.92				1
Cyperus polystachyos	1.56				1
Echinochloa walteri	2.50				1

SPECIES	CofC	Region			
		2	5	8	11
Eupatorium capillifolium	0.83	1			
Gordonia lasianthus	7.00			1	
Hygrophila polysperma	0.00			1	
Ilex cassine	6.00				1
Juncus marginatus	1.50			1	
Lachnanthes caroliniana	3.76		1		
Nuphar	3.50		1		
Osmunda regalis	7.60			1	
Panicum maximum	0.00	1			
Paspalidium geminatum	5.50	1			
Persea palustris	7.00			1	
Pontederia cordata	5.38		1		
Rhexia mariana	4.00				1
Rumex verticillatus	3.17				1
Sagittaria lancifolia	3.00				1
Sambucus nigra	1.48	1			
Sphagneticola trilobata	0.00				1
Utricularia gibba	6.37		1		
Vaccinium corymbosum	5.63			1	
Vallisneria americana	7.00				1
Woodwardia virginica	3.50			1	

Table 3: Scoring Summary for the Lake Vegetation Index

LVI Score Summary	Region			
	2	5	8	11
Total # of taxa in sampling unit	31	28	36	38
% Native taxa in sampling unit	67.74194	71.42857	72.22222	73.68421
% FLEPPC CAT 1 taxa in sampling unit	22.58065	17.85714	22.22222	18.42105
% Sensitive taxa in sample unit	3.225806	0	8.33333	5.263158
Dominant CoC in sample unit	0	1.475	0	0

Native Score ((x-62.5)/37.5) or ((x-66.67)/25.89)=	0.041403	0.1838	0.214454	0.270924
Invasive FLEPPC 1 Score (1 - (x/30))=	0.247312	0.404762	0.259259	0.385965
Sensitive Score (x/(27.78 or 20)) =	0.16129	0	0.416667	0.263158
Dominant CoC Score (x/(7.91 or 7)) =	0	0.210714	0	0
Raw Score Total = N+I+S+D =	0.450006	0.799276	0.89038	0.920046
Division Factor = (3 D=0 or 4) =	4	4	4	4
Average LVI dividend = Raw /DF	0.112501	0.199819	0.222595	0.230012
South				
LVI Score for sampling unit =	11.25014	19.98189	22.25951	23.00116

Total LVI SCORE =

19

Water Quality Assessment

Limited long-term water quality data is available for Lake Grady. The available data was collected by Hillsborough County in late 2018 and 2019 and consists of five samples with three samples during the dry season (10/30/18, 2/25/19 & 4/9/19) and two samples during the wet season (5/20/19, 7/9/19). Table 4 provides a summary of the Physical/Chemical conditions recorded at the middle of the Lake Grady.

Table 4: Lake Grady Water Quality (Field)

Depth (m)	Temp °C	pH	DO (mg/L)	DO (%sat)	Cond (unho/cm)	Salinity (ppt)	Secchi Depth (m)
0.15	29.38	7.26	12.7	164.3	158.6	0.07	0.88
1.03	28.93	7.08	9.29	119.3	153.7	0.07	
1.76	28.17	6.88	4.95	62.7	153.1	0.07	
POR	25.61	6.79	6.48	79.08	159.9	0.08	

The chemical water quality analysis for Lake Grady is shown in Table 5 for the sample taken on May 20, 2019. 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 (10/31/18- 7/9/19) since complete data for the past three years for available parameters is not available. Total Phosphorous values were above the nutrient threshold for clear alkaline lakes (Alkalinity > 20 mg/l CaCO₃ and color < 40 PCU) in the west central region with insufficient data developed by FDEP of 0.03 mg/l with a value of 0.160 mg/l for the POR. If sampling were to be sufficient (previous three years of quarterly sampling) the threshold could be as high as 0.09 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 0.771 mg/l for the POR data.. If sampling were to be sufficient (previous three years of quarterly sampling) the threshold could be as high as 1.91 mg/L. Chlorophyll-a corrected values are above the nutrient threshold for clear - alkaline lakes developed by FDEP of 20.0 µg/l with a value of 25.99 µg/l for POR data (108.1 µg/l for the 5/20/19 sample).

Bacteria testing showed low levels of E. Coli (4.34 colonies/100ml) and Enterococci (15.35 colonies/100ml) for the POR, 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 Grady Water Quality Results from 5/20/19 (Laboratory)

Parameter	Lake Grady (Center)	POR Mean Value	Units
Alkalinity	20.0	20.0	mg/LCaCO ₃
Ammonia	0.005	0.007	mg/L
Chlorophyll a	113.1	31.81	ug/L
Chlorophyll b	0.2	1.116	ug/L
Chlorophyll c	4.7	1.962	ug/L
Chlorophyll t	117.8	35.77	ug/L
Chlorophylla Corr	108.1	25.99	ug/L
Chlorophyll-pheo	1.4	5.62	ug/L
Color(345)F.45	16.8	16.8	Pt/Co
E Coli	<4	4.34	#/100ml
Enterococci	<4	15.35	#/100 ml
Kjeldahl Nitrogen	1.265	0.767	mg/L
Nitrates/Nitrites	0.018	0.013	mg/L
Total Nitrogen	1.265	0.771	mg/L
Total Phosphorus	0.116	0.160	mg/L

Table 6: Numeric Nutrient Criteria Framework

Parameter	Value
Geometric Mean (Geomean) Color (pcu)	16.8
Number of Samples	1
Geometric Mean Alkalinity (mg/L CaCO ₃)	20.0
Number of Samples	1
Lake Type	Clear - Alkaline
Chlorophyll a Criteria (ug/L)	20
Insufficient for Geomean Criteria then P mg/L	0.03
Insufficient for Geomean Criteria then N mg/L	1.05
2018-2019 Geomean Chla Corrected ug/L	25.99
2018-2019 Geomean TP mg/L	0.160
2018-2019 Geomean TN mg/L	0.771
Number of Samples	5
Potential Impaired Chlorophyll a	Impaired
Potential Impaired TP	Impaired
Potential Impaired TN	Not Impaired

Table 7: FDEP Numeric Nutrient Criteria Values

Long Term Geometric Mean Lake Color and Alkalinity	Annual Geometric Mean Chlorophyll <i>a</i>	Minimum calculated numeric interpretation		Maximum calculated numeric interpretation	
		Annual Geometric Mean Total Phosphorus	Annual Geometric Mean Total Nitrogen	Annual Geometric Mean Total Phosphorus	Annual Geometric Mean Total Nitrogen
> 40 Platinum Cobalt Units	20 µg/L	0.05 mg/L	1.27 mg/L	0.16 mg/L ¹	2.23 mg/L
≤ 40 Platinum Cobalt Units and > 20 mg/L CaCO ₃	20 µg/L	0.03 mg/L	1.05 mg/L	0.09 mg/L	1.91 mg/L
≤ 40 Platinum Cobalt Units and ≤ 20 mg/L CaCO ₃	6 µg/L	0.01 mg/L	0.51 mg/L	0.03 mg/L	0.93 mg/L

¹ For lakes with color > 40 PCU in the West Central Nutrient Watershed Region, the maximum TP limit is 0.49 mg/L, which is the TP streams threshold for the region.

Conclusion

The results of the assessment of Lake Grady shows an impaired lake based on Chlorophyll-a and Total Phosphorous concentrations according 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 with only the end of 2018 and 2019 having suitable data. Consistent Long term sampling would be necessary to determine actual NNC values with a minimum of three samples per year (quarterly preferred) for the previous three years. The available values for Chlorophyll-a and Total Phosphorous are above the nutrient threshold. Of note in the limited water quality data that is available is the marked increase in Chlorophyll-a corrected and Total Nitrogen values in the rainy season.

The system also shows impairment in the vegetation communities according to the Lake Vegetation Index with high overall species (64), but moderate occurrences of non-native, invasive species and few sensitive plant species with an overall LVI score of 19. The assessment observed a very small submerged aquatic vegetation at the time of the assessment occupying 1.4% of the lakes surface area and 0.05% of the lakes volume.