Lake Assessment Report for
Josephine Lake
in Hillsborough County, Florida

Date Assessed: July 8, 2010
Assessed by: David Eilers
Reviewed by: Jim Griffin

INTRODUCTION

This assessment was conducted to update existing physical and ecological data for Josephine Lake on the Hillsborough County & City of Tampa Water Atlas. The project is a collaborative effort between the University of South Florida's Center for Community Design and Research and Hillsborough County Stormwater Management Section. The project is funded by Hillsborough County and the Southwest Florida Water Management District's Northwest Hillsborough, Hillsborough River and Alafia River Basin Boards. The project has, as its primary goal, the rapid assessing of up to 150 lakes in Hillsborough County during a five-year period. The product of these investigations will provide the County, lake property owners and the general public a better understanding of the general health of Hillsborough County lakes, in terms of shoreline development, water quality, lake morphology (bottom contour, volume, area, etc.) and the plant biomass and species diversity. These data are intended to assist the County and its citizens to better manage lakes and lake-centered watersheds.

Figure 1. General photo of Josephine Lake

The first section of the report provides the results of the overall morphological assessment of the lake. Primary data products include: a contour (bathymetric) map of the lake, area, volume and depth statistics, and the water level at the time of assessment. These data are useful for evaluating trends and for developing management actions such as plant management where depth and lake volume are needed.

The second section provides the results of the vegetation assessment conducted on the lake. These results can be used to better understand and manage vegetation in the lake. A list is provided with the different plant species found at various sites around the lake. Potentially invasive, exotic (non-native) species are identified in a plant list and the percent of exotics is presented in a summary table. Watershed values provide a means of reference.

The third section provides the results of the water quality sampling of the lake. Both field data and laboratory data are presented. The trophic state index (TSI)[i] is used to develop a general lake health statement, which is calculated for both the water column with vegetation and the water column if vegetation were removed. These data are derived from the water chemistry and vegetative submerged biomass assessments and are useful in understanding the results of certain lake vegetation management practices.

The intent of this assessment is to provide a starting point from which to track changes in the lake, and where previous comprehensive assessment data is available, to track changes in the lake's general health. These data can provide the information needed to determine changes and to monitor trends in physical condition and ecological health of the lake.

Section 1: Lake Morphology

Bathymetric Map[ii]. Table 1 provides the lake's morphologic parameters in various units. The bottom of the lake was mapped using a Lowrance LCX 28C HD Wide Area Augmentation System (WAAS)[iii] 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 (Figure 2). 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.

Table 1. Lake Morphologic Data (Area, Depth and Volume)

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	2,103,512	195,423	48.29		
Mean Depth	7	2.10			
Maximum Depth	24	7.30			
Volume (cubic)	14,903,705	422,026		342.10	111,487,453
Gauge (relative)	45.14	13.76			

[i] The trophic state index is used by the Water Atlas to provide the public with an estimate of their lake resource quality. For more information, see end note 1.
[ii] 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.
[iii] 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.

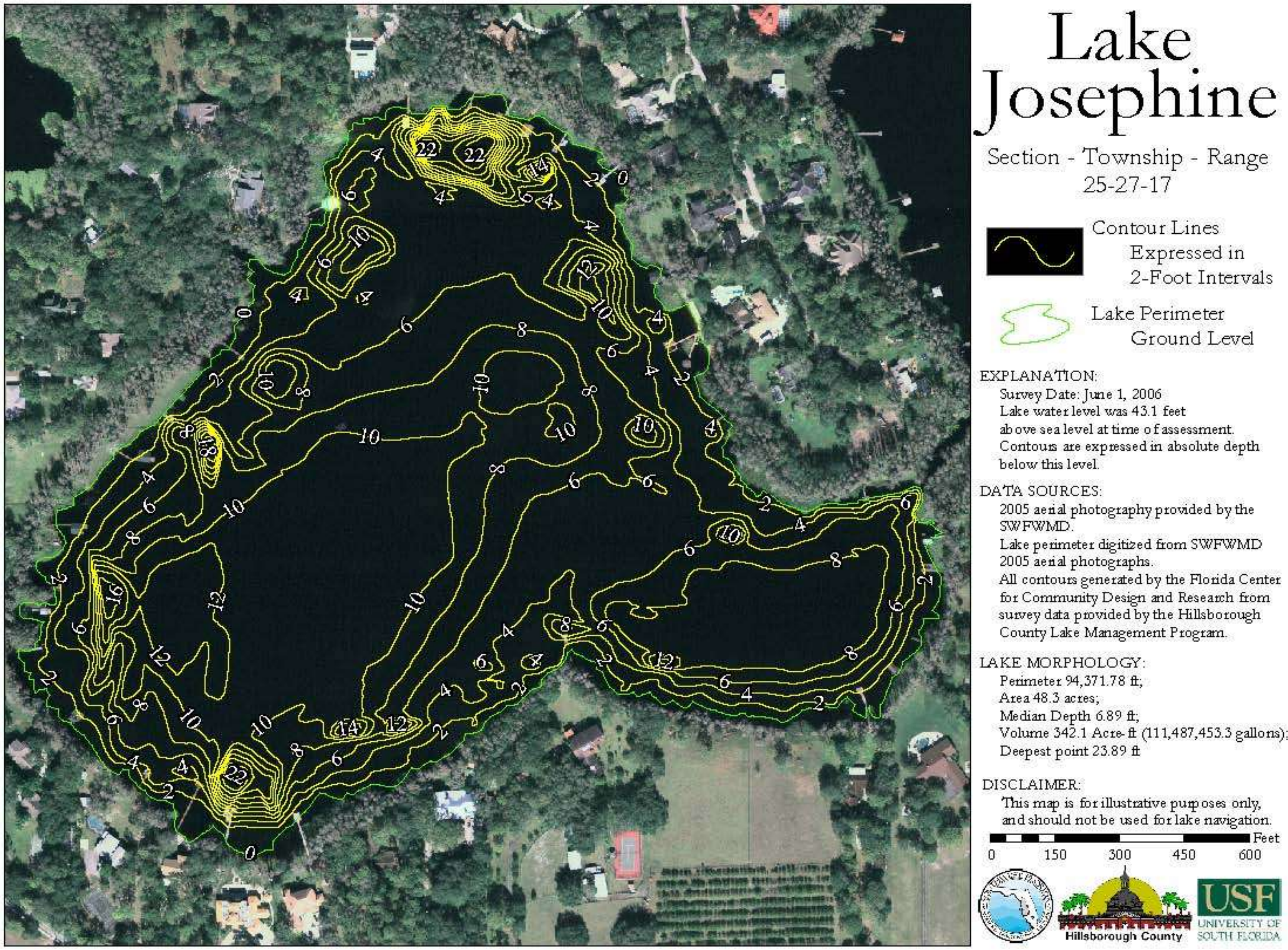


Figure 2. Josephine Lake Bathymetric Contour Map 2006

Section 2: Lake Ecology (Vegetation)

The lake's apparent vegetative cover and shoreline detail are evaluated using the latest lake aerial photograph as shown in and by use of WAAS-enabled GPS. Submerged vegetation is determined from the analysis of bottom returns from the Lowrance 28c HD combined GPS/fathometer described earlier. As depicted in Figure 3, 10 vegetation assessment sites were chosen for intensive sampling based on the *Lake Assessment Protocol* (copy available on request) for a lake of this size. The site positions are set using GPS and then loaded into a GIS mapping program (ArcGIS) for display. Each site is sampled in the three primary vegetative zones (emergent, submerged and floating)[iv]. The latest high resolution aerial photos are used to provide shore details (docks, structures, vegetation zones) and to calculate the extent of surface vegetation coverage. The primary indices of submerged vegetation cover and biomass for the lake, percent area coverage (PAC) and percent volume infestation (PVI), are determined by transiting the lake by boat and employing a fathometer to collect "hard and soft return" data. These data are later analyzed for presence and absence of vegetation and to determine the height of vegetation if present. The PAC is determined from the presence and absence analysis of 100 sites in the lake and the PVI is determined by measuring the difference between hard returns (lake bottom) and soft returns (top of vegetation) for sites (within the 100 analyzed sites) where plants are determined present.

Beginning with the 2010 Lake Assessments, the Water Atlas Lake Assessment Team has added the Florida Department of Environmental Protection (FDEP) Lake Vegetation Index (LVI)[v] method to the methods used to evaluate a lake. The LVI method was designed by DEP to be a rapid assessment of ecological condition, by determining how closely a lake's flora resembles that expected from a minimally disturbed condition.

The data collected during the site vegetation sampling include vegetation type, exotic vegetation, predominant plant species and submerged vegetation biomass. The total number of species from all sites is used to approximate the total diversity of aquatic plants and the percent of invasive-exotic plants on the lake (Table 2). The Watershed value in Table 2 only includes lakes sampled during the lake assessment project begun in May of 2006. These data will change as additional lakes are sampled. Table 3 through Table 5 detail the results from the 2010 aquatic plant assessment for the lake. These data are determined from the 10 sites used for intensive vegetation surveys. The tables are divided into Floating Leaf, Emergent and Submerged plants and contain the plant code, species, common name and presence (indicated by a 1) or absence (indicated by a blank space) of species and the calculated percent occurrence (number sites species is found/number of sites) and type of plant (Native, Non-Native, Invasive, Pest). In the "Type" category, the codes N and E0 denote species native to Florida. The code E1 denotes Category I invasive species, as defined by the Florida Exotic Pest Plant Council (FLEPPC); these are species "that are altering native plant communities by displacing native species, changing community structures or ecological functions, or hybridizing with natives." The code E2 denotes Category II invasive species, as defined by FLEPPC; these species "have increased in abundance or frequency but have not yet altered Florida plant communities to the extent shown by Category I species." Use of the term invasive indicates the plant is commonly considered invasive in this region of Florida. The term "pest" indicates a plant (native or non-native) that has a greater than 55% occurrence in the lake and is also considered a problem plant for this region of Florida, or is a non-native invasive that is or has the potential to be a problem plant in the lake and has at least 40% occurrence. These two terms are somewhat subjective; however, they are provided to give lake property owners some guidance in the management of plants on their property. Please remember that to remove or control plants in a wetland (lake shoreline) in Hillsborough County the property owner must secure an Application To Perform Miscellaneous Activities In Wetlands permit from the Environmental Protection Commission of Hillsborough County and for management of in-lake vegetation outside the wetland fringe (for lakes with an

---

[iv] See end note 3.
[v] See end note 4.

area greater than ten acres), the property owner must secure a Florida Department of Environmental Protection Aquatic Plant Removal Permit.

Table 2. Total Diversity, Percent Exotics, and Number of Pest Plant Species

Parameter	Lake	Watershed
Number of Vegetation Assessment Sites	10	169
Total Plant Diversity (# of Taxa)	67	178
% Non-Native Plants	27	17
Total Pest Plant Species	9	25

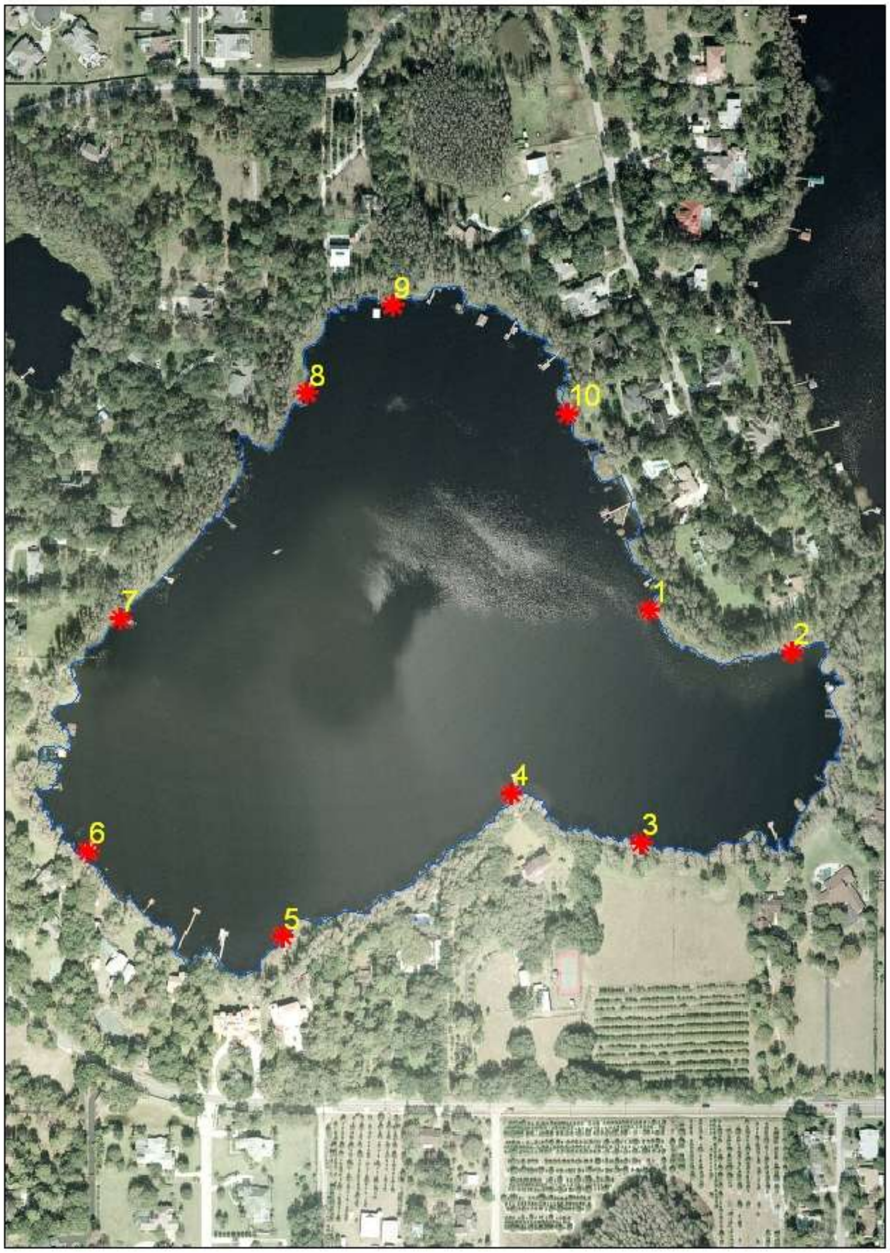


Figure 3. Josephine Lake Vegetation Assessment Site Map

Table 3. List of Floating Leaf Zone Aquatic Plants Found

Plant Species Code	Scientific Name	Common Name	Percent Occurrence	Type
ECS	*Eichornia crassipes*	Water Hyacinth	100%	E1, P
NNC	*Nymphoides cristata*	Crested Banana Lily, Crested Floatingheart	100%	E1, P
SMA	*Salvinia minima*	Water Spangles, Water Fern	100%	N, E0, P
NLM	*Nuphar lutea*	Spatterdock, Yellow Pondlily	90%	N, E0
SPI	*Spirodela polyrhiza*	Giant Duckweed	80%	N, E0
LEN	*Lemna spp.*	Duckweed	80%	N, E0
PSS	*Pistia stratiotes*	Water Lettuce	40%	E1, P
SPY	*Spirogyra spp.*	Filamentous Algae, Algal Mats	20%	N, E0
ALG	*Algal spp.*	Algal Mats, Floating	20%	
ACA	*Azolla caroliniana*	Carolina Mosquito Fern	10%	N, E0

Figure 4. Photograph of Eichhornia crassipes, a non-native invasive species, on Josephine Lake

Table 4. List of Emergent Zone Aquatic Plants Found

Plant Species Code	Scientific Name	Common Name	Percent Occurrence	Type
TAS	*Taxodium acendens*	Pond Cypress	100%	N, E0
SCS	*Scirpus cubensis*	Burhead Sedge,Cuban Scirpus	90%	N, E0, P
ACE	*Acer rubrum*	Southern Red Maple	90%	N, E0
APS	*Alternanthera philoxeroides*	Alligator Weed	80%	E2, P
LPA	*Ludwigia peruviana*	Peruvian Primrosewillow	80%	E0, P
MEL	*Melaleuca quinquenervia*	Punk Tree, Melaleuca	70%	E1, P
BLS	*Blechnum serrulatum*	Swamp fern, Toothed Midsorus Fern	70%	N
COS	*Cephalanthus occidentalis*	Buttonbush	70%	N, E0
ICE	*Ilex cassine*	Dahoon Holly	70%	N, E0
MSS	*Mikania scandens*	Climbing Hempvine	70%	N, E0
QLA	*Quercus laurifolia*	Laurel Oak; Diamond Oak	60%	N, E0
PRS	*Panicum repens*	Torpedo Grass	60%	E1, P
WAX	*Myrica cerifera*	Wax Myrtle	60%	N, E0
PCA	*Pontederia cordata*	Pickerel Weed	50%	N, E0
CHN	*Cyperus haspan*	Haspan Flatsedge	50%	N, E0
HYE	*Hydrocotyl umbellata*	Manyflower Marshpennywort, Water Pennywort	40%	N, E0
SAL	*Salix spp.*	Willow	40%	N, E0
PHN	*Panicum hemitomon*	Maidencane	40%	N, E0
PBA	*Persea borbonia*	Redbay	40%	N, E0
SLA	*Sagittaria lancifolia*	Duck Potato	40%	N, E0
POL	*Polygonum spp.*	Smartweed, Knotweed	30%	N, E0
LRS	*Ludwigia repens*	Creeping Primrosewillow, Red Ludwigia	30%	N, E0
CYO	*Cyperus odoratus*	Fragrant Flatsedge	30%	N, E0
BOC	*Boehmeria cylindrica*	Bog Hemp, False Nettle	30%	N, E0
CEA	*Colocasia esculenta*	Wild Taro	30%	E1
CER	*Ceratopteris thalictroides*	Water Sprite	20%	E0
DVA	*Diodia virginiana*	Buttonweed	20%	N, E0
RF	*Osmunda regalis*	Royal Fern	20%	N, E0
SPO	*Sabal palmetto*	Sabal Palm, Cabbage Palm	20%	N, E0
SSM	*Sapium sebiferum*	Chinese Tallow Tree	20%	E1
STS	*Schinus terebinthifolius*	Brazilian Pepper	20%	E1
TDM	*Taxodium distichum*	Bald Cypress	20%	N, E0
TYP	*Typha spp.*	Cattails	20%	N, E0
VRA	*Vitis rotundifolia*	Muscandine Grape	20%	N, E0
WTA	*Wedelia trilobata*	Creeping Oxeye	10%	E2

Plant Species Code	Scientific Name	Common Name	Percent Occurrence	Type
ULA	*Urena lobata*	Caesar's-weed	10%	N, E2
SMI	*Smilax spp.*	Catbriar, Greenbriar	10%	N, E0
SHA	*Sesbania herbacea*	Danglepod Sesban	10%	N, E0
PQA	*Parthenocissus quinquefolia*	Virginia Creeper, Woodbine	10%	N, E0
PIN	*Pinus spp.*	Pine Tree	10%	N, E0
MAM	*Myriophyllum aquaticum*	Parrot Feather	10%	E0
LOS	*Ludwigia octovalvis*	Mexican Primrosewillow, Long-stalked Ludwigia	10%	N, E0
PFO	*Paederia foetida*	Skunkvine, Stinkvine	10%	E1
MVA	*Magnolia virginiana*	Sweetbay Magnolia	10%	N, E0
OCA	*Osmunda cinnamomea*	Cinnamon Fern	10%	N, E0
EWI	*Echinochloa walteri*	Coast Cockspur Grass (hairy)	10%	N, E0
FSR	*Fuirena scirpoidea*	Southern Umbrellasedge	10%	N, E0
AAA	*Ampelopsis arborea*	Peppervine	10%	N, E0
CPT	*Cyperus polystachyos*	Flat Sedge	10%	N, E0
CFA	*Canna flaccida*	Golden Canna	10%	N, E0
CLA	*Casuarina equisetifolia*	Australian Pine	10%	E1
COM	*Commelina spp.*	Dayflower	10%	N, E0
BID	*Bidens spp.*	Bur Marigold	10%	N, E0

Figure 5. Photograph of Sagittaria lancifolia, a native species of emergent vegetation, on Josephine Lake

Table 5. List of Submerged Zone Aquatic Plants Found.

Plant Species Code	Scientific Name	Common Name	Percent Occurrence	Type
UTA	*Utricularia spp.*	Bladderwort	60%	N, E0
EBI	*Eleocharis baldwinii*	Baldwin's Spikerush, Roadgrass	30%	N, E0
NGS	*Najas guadelupensis*	Southern Naiad	20%	N, E0
BMI	*Bacopa monnieri*	Common Bacopa	10%	N, E0

Table 6. List of All Plants and Sample Sites

Plant Common Name	Found at Sample Sites	Percent Occurrence	Growth Type
Crested Banana Lily, Crested Floatingheart	1,2,3,4,5,6,7,8,9,10	100	Floating
Pond Cypress	1,2,3,4,5,6,7,8,9,10	100	Emergent
Water Hyacinth	1,2,3,4,5,6,7,8,9,10	100	Floating
Water Spangles, Water Fern	1,2,3,4,5,6,7,8,9,10	100	Floating
Burhead Sedge,Cuban Scirpus	1,2,3,5,6,7,8,9,10	90	Emergent
Southern Red Maple	1,2,3,4,5,7,8,9,10	90	Emergent
Spatterdock, Yellow Pondlily	1,3,4,5,6,7,8,9,10	90	Floating
Alligator Weed	2,3,4,5,6,7,8,9	80	Emergent
Duckweed	2,3,4,6,7,8,9,10	80	Floating
Giant Duckweed	1,2,3,6,7,8,9,10	80	Floating
Peruvian Primrosewillow	1,2,5,6,7,8,9,10	80	Emergent
Buttonbush	2,3,4,5,6,7,8	70	Emergent
Climbing Hempvine	1,3,5,6,8,9,10	70	Emergent
Dahoon Holly	1,3,4,5,7,8,9	70	Emergent
Punk Tree, Melaleuca	3,4,5,6,7,8,10	70	Emergent
Swamp fern, Toothed Midsorus Fern	1,2,4,5,6,8,9	70	Emergent
Bladderwort	1,3,6,7,8,10	60	Submersed
Laurel Oak; Diamond Oak	1,2,3,4,5,7	60	Emergent
Torpedo Grass	2,4,5,6,7,9	60	Emergent
Wax Myrtle	2,3,4,5,8,9	60	Emergent
Haspan Flatsedge	3,6,7,8,9	50	Emergent
Pickerel Weed	3,5,7,8,10	50	Emergent
Duck Potato	6,7,9,10	40	Emergent
Maidencane	3,4,5,7	40	Emergent
Manyflower Marshpennywort, Water Pennywort	2,3,6,7	40	Emergent
Redbay	2,3,4,9	40	Emergent
Water Lettuce	2,3,5,7	40	Floating
Willow	3,5,7,9	40	Emergent
Baldwin's Spikerush, Roadgrass	1,2,6	30	Submersed
Bog Hemp, False Nettle	3,5,9	30	Emergent
Creeping Primrosewillow, Red Ludwigia	3,6,9	30	Emergent
Fragrant Flatsedge	2,6,7	30	Emergent

Plant Common Name	Found at Sample Sites	Percent Occurrence	Growth Type
Smartweed, Knotweed	2,3,8	30	Emergent
Wild Taro	4,5,7	30	Emergent
Algal Mats, Floating	2,3	20	Floating
Bald Cypress	1,10	20	Emergent
Brazilian Pepper	4,9	20	Emergent
Buttonweed	7,9	20	Emergent
Cattails	7,9	20	Emergent
Chinese Tallow Tree	2,3	20	Emergent
Filamentous Algae, Algal Mats	6,9	20	Floating
Muscandine Grape	4,5	20	Emergent
Royal Fern	4,5	20	Emergent
Sabal Palm, Cabbage Palm	4,6	20	Terrestrial
Southern Naiad	9,10	20	Submersed
Water Sprite	2,3	20	Emergent
Australian Pine	10	10	Emergent
Bur Marigold	9	10	Emergent
Caesar's-weed	3	10	Emergent
Carolina Mosquito Fern	3	10	Floating
Catbriar, Greenbriar	4	10	Emergent
Cinnamon Fern	9	10	Emergent
Coast Cockspur Grass (hairy)	6	10	Emergent
Common Bacopa	7	10	Submersed
Creeping Oxeye	7	10	Emergent
Danglepod Sesban	3	10	Emergent
Dayflower	7	10	Emergent
Flat Sedge	2	10	Emergent
Golden Canna	10	10	Emergent
Mexican Primrosewillow, Long-stalked Ludwigia	10	10	Emergent
Parrot Feather	7	10	Emergent
Peppervine	4	10	Emergent
Pine Tree	3	10	Emergent
Skunkvine, Stinkvine	4	10	Terrestrial
Southern Umbrellasedge	3	10	Emergent

Plant Common Name	Found at Sample Sites	Percent Occurrence	Growth Type
Sweetbay Magnolia	**9**	**10**	**Emergent**
Virginia Creeper, Woodbine	**3**	**10**	**Emergent**

Section 3: Long-term Ambient Water Chemistry

A critical element in any lake assessment is the long-term water chemistry data set. These data are obtained from several data sources that are available to the Water Atlas and are managed in the Water Atlas Data Download and graphically presented on the water quality page for lakes in Hillsborough County. The Josephine Lake Water Quality Page can be viewed at http://www.hillsborough.wateratlas.usf.edu/lake/waterquality.asp?wbodyid=5126&wbodyatlas=lake).

A primary source of lake water chemistry in Hillsborough County is the Florida LAKEWATCH volunteer lake monitor and the Florida LAKEWATCH laboratory at the University of Florida. Josephine Lake is fortunate to have an active LAKEWATCH volunteer who has collected lake water samples for significant time period which allow an analysis of lake trends. Other source data are used as available; however these data can only indicate conditions at time of sampling.

These data are displayed and analyzed on the Water Atlas as shown in Figure 6Figure 6, Figure 7, and Figure 8 for Josephine Lake. The figures are graphs of: (1) the overall trophic state index (TSI)[i], which is a method commonly used to characterize the productivity of a lake, and may be thought of as a lake's ability to support plant growth and a healthy food source for aquatic life; (2) the chlorophyll *a* concentration, which indicates the lake's algal concentration, and (3) the lake's Secchi Disk depth which is a measure of water visibility and depth of light penetration. These data are used to evaluate a lake's ecological health and to provide a method of ranking lakes and are indicators used by the US Environmental Protection Agency (USEPA) and the Florida Department of Environmental Protection (FDEP) to determine a lake's level of impairment. The chlorophyll a and Secchi Disk depth graphs include benchmarks which indicate the median values for the various parameters for a large number of Lakes in Florida expressed as percentiles.

Based on best available data, Josephine Lake has a color value determined as a platinum cobalt unit (pcu) value of 95 and is considered a Dark lake(has a mean color in pcu greater than 40). The FDEP and USEPA may classify a lake as impaired if the lake is a dark lake and has a TSI greater than 60, or is a clear lake (has a mean color in pcu less than or equal to 40) and has a TSI greater than 40. Josephine Lake has a TSI of 66 and meets the FDEP Impaired Waters Rule (IWR) criteria and could be classified as impaired. See also Table 7.

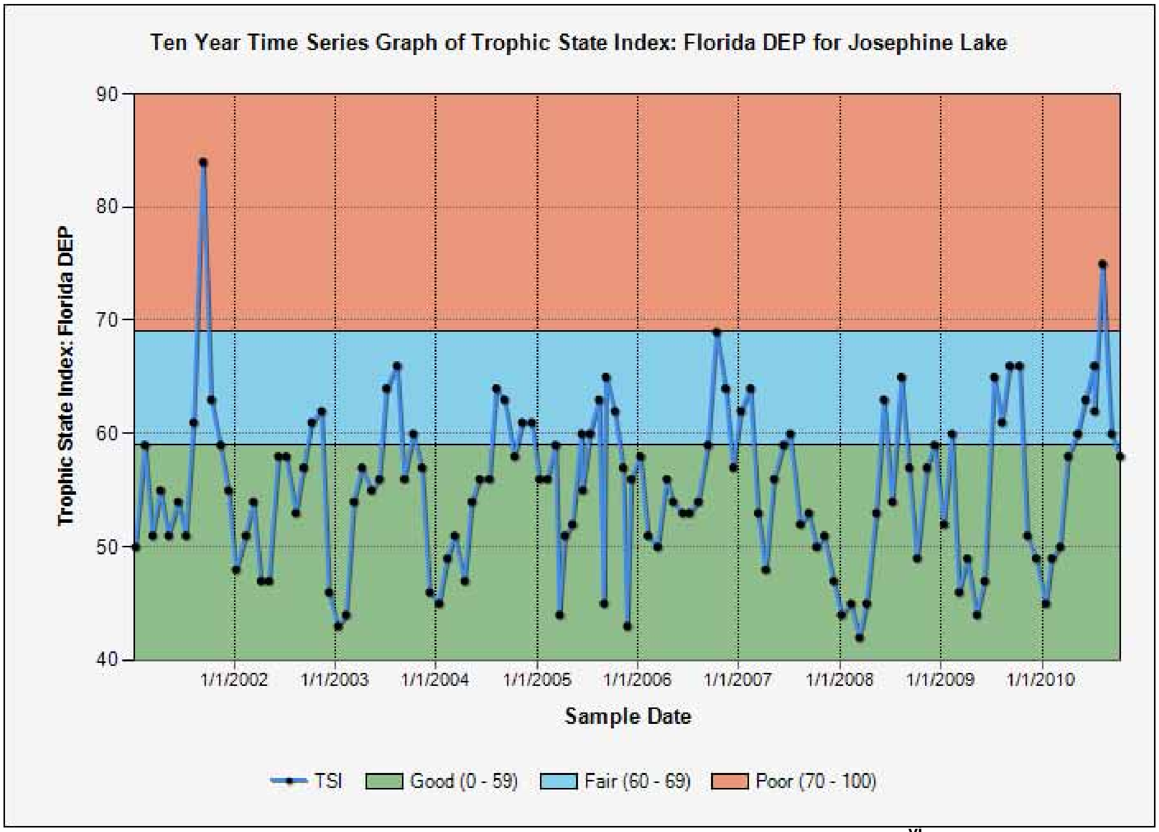


Figure 6. Recent Trophic State Index (TSI) graph for Josephine Lake[vi]

[vi] Graph source: Hillsborough County Water Atlas. For an explanation of the Good, Fair and Poor benchmarks, please see the notes at the end of this report. For the latest data go to: http://www.hillsborough.wateratlas.usf.edu/graphs20/graph_it.aspx?wbodyid=5126&data=TSI&datatype=WQ&waterbodyatlas=lake&ny=10&bench=1

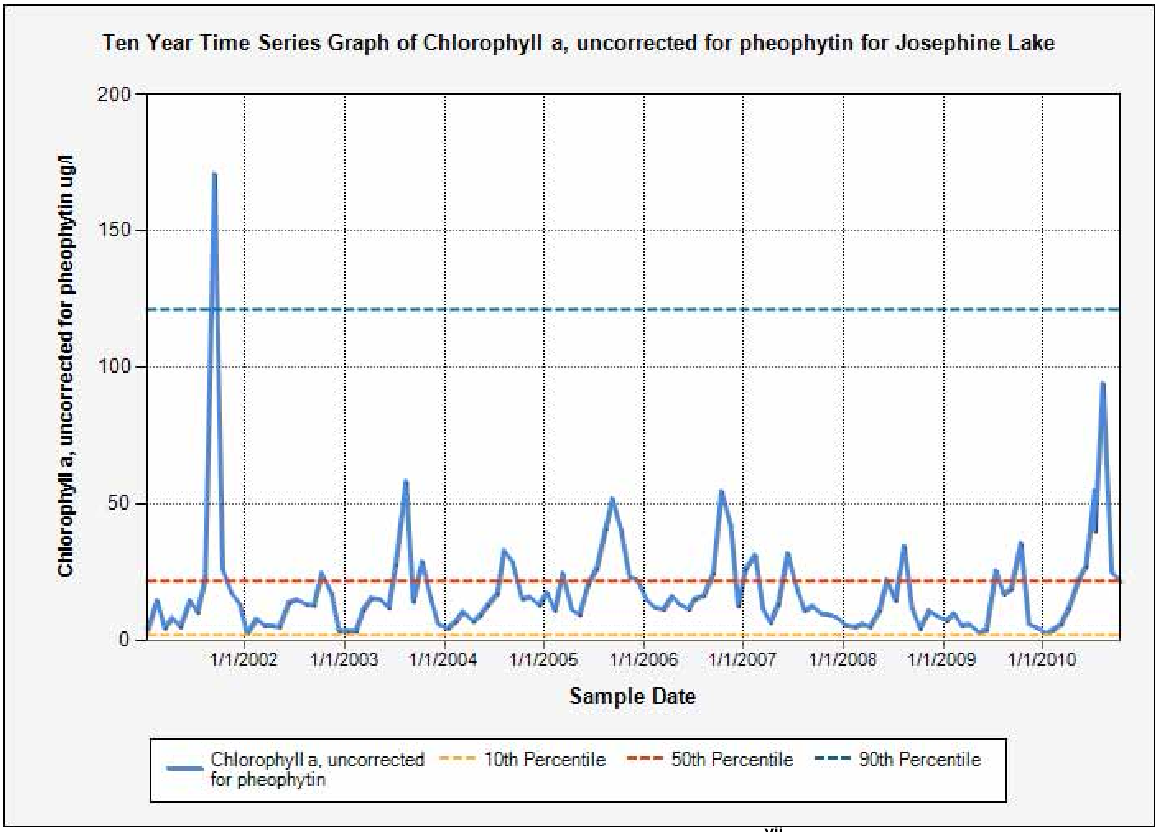


Figure 7. Recent Chlorophyll a graph for Josephine Lake[vii]

[vii] Graph Source: Hillsborough County Water Atlas. For the latest data go to http://www.hillsborough.wateratlas.usf.edu/graphs20/graph_it.aspx?wbodyid=5126&data=Chla_ugl&datatype=WQ&waterbodyatlas=lake&ny=10&bench=1

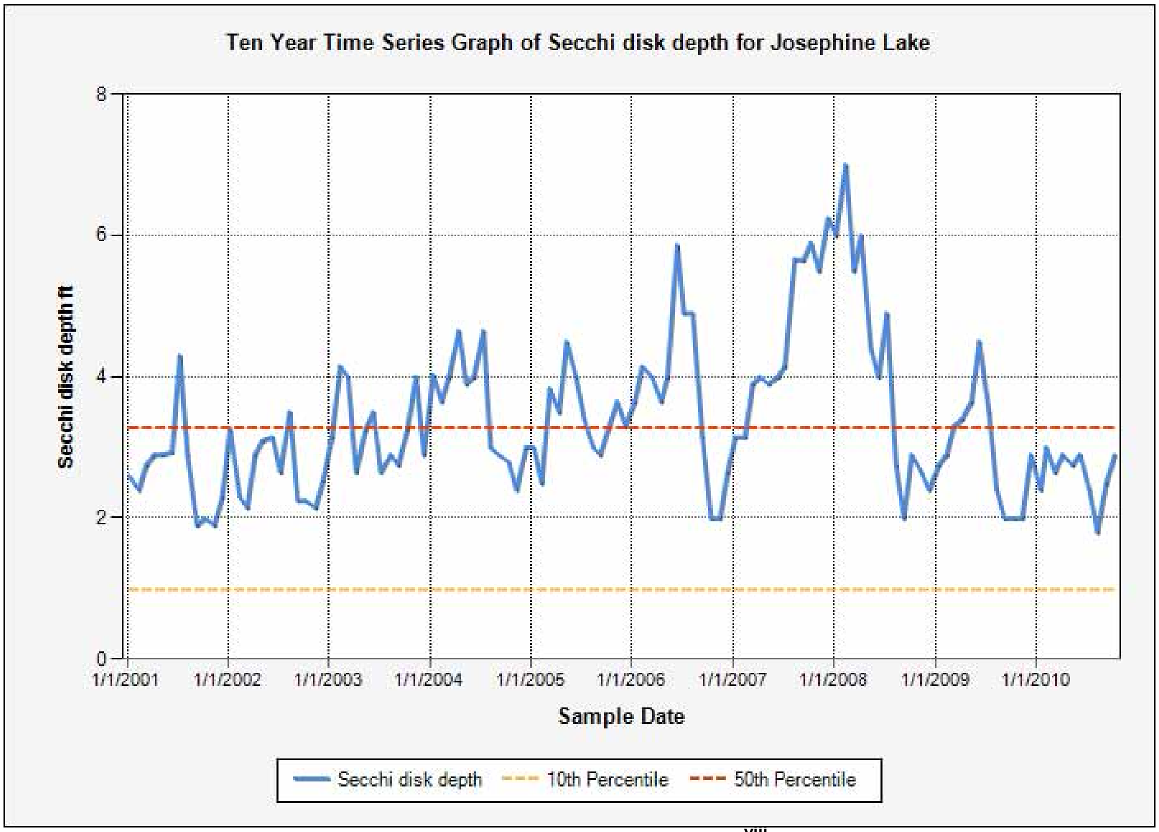


Figure 8. Recent Secchi Disk graph for Josephine Lake[viii]

As part of the lake assessment the physical water quality and chemical water chemistry of a lake are measured. These data only indicate a snapshot of the lake's water quality; however they are useful when compared to the trend data available from LAKEWATCH or other sources. Table 7 contains the summary water quality data and index values and adjusted values calculated from these data. The total phosphorus (TP), total nitrogen (TN) and chlorophyll *a* water chemistry sample data are the results of chemical analysis of samples taken during the assessment and analyzed by the Hillsborough County Environmental Protection Commission laboratory.

The growth of plants (planktonic algae, macrophytic algae and rooted plants) is directly dependent on the available nutrients within the water column of a lake and to some extent the nutrients which are held in the sediment and the vegetation biomass of a lake. Additionally, algae and other plant growth are limited by the nutrient in lowest concentration relative to that needed by a plant. Plant biomass contains less phosphorus by weight than nitrogen so phosphorus is many times the limiting nutrient. When both nutrients are present at a concentration in the lake so that either or both may restrict plant growth, the limiting factor is called "balanced". The ratio of total nitrogen to total phosphorous, the "N to P" ratio (N/P), is used to determine the limiting factor. If N/P is greater than or equal to 30, the lake is considered phosphorus limited, when this ratio is less than or equal to 10, the lake is considered nitrogen limited and if between 10 and 30 it is considered balanced.

[viii] Graph Source: Hillsborough County Water Atlas. For the latest data go to http://www.hillsborough.wateratlas.usf.edu/graphs20/graph_it.aspx?wbodyid=5126&data=secchi_ft&datatype=WQ&waterbodyatlas=lake&ny=10&bench=1

Table 7. Water Quality Parameters (Laboratory) for Josephine Lake

Parameter	Value
Lake Area (Acres)	48.29
Lake Area (m2)	195,423.00
Lake Volume (m3)	422,026.00
Number of Vegetation Sites	10
Average Station SAV Weight	0.01
Wet Weight of Vegetation (g)	117,253.62
Dry Weight of Vegetation (g)	9,380.29
Total Phosphorus (ug/L)	79.00
Total Nitrogen (ug/L)	970.00
Chlorophyll a (ug/L)	55.10
TN/TP	12.3
Limiting Nutrient	Balanced
Chlorophyll TSI	74
Phosphorus TSI	62
Nitrogen TSI	55
TSI	66
Color (PCU)	95.00
Secchi disk depth (ft)	3.50
Impaired TSI for Lake	60
Lake Status (Water Column)	Impaired

The color of a lake is also important to the growth of algae. Dark, tannic lakes tend to suppress algal growth and can tolerate a higher amount of nutrient in their water column; while clear lakes tend to support higher algal growth with the same amount of nutrients. The color of a lake, which is measured in a unit called the “cobalt platinum unit (PCU)” because of the standard used to determine color, is important because it is used by the State of Florida to determine lake impairment as explained earlier. A new rule which is being developed by USEPA and FDEP, will use alkalinity in addition to color to determine a second set of “clear-alkaline lakes” which will be allowed a higher TSI than a “clear-acid” lake. This is because alkaline lakes have been found to exhibit higher nutrient and algal concentrations than acid lakes. Additionally, lakes connected to a river or other “flow through” system tend to support lower algal growth for the same amount of nutrient concentration. All these factors are important to the understanding of your lake’s overall condition. Table 7 includes many of the factors that are typically used to determine the actual state of plant growth in your lake. These data should be understood and reviewed when establishing a management plan for a lake; however, as stated above other factors must be considered when developing such a plan. Please contact the Water Atlas Program if you have questions about this part or any other part of this report.

The phosphorus sample concentration is significantly higher than the mean of long term sample data (34 µg/L) for the lake. These data are being verified. However, the Chlorophyll concentration which indicates the extent of algal growth is also high and the general trend for the lake is to have higher nutrient and chlorophyll concentrations in the summer months (see Figures 7-9). The lake is normally balanced and algae (chlorophyll concentration) growth is managed by both phosphorus and nitrogen. The resulting TSI is therefore considered to be a reasonable estimate for the lake and based on this the lake should be considered impaired for nutrients.

Table 8 provides data derived from the vegetation assessment which is used to determine an adjusted TSI. This is accomplished by calculating the amount of phosphorus and nitrogen that could be released by existing submerged vegetation (Adjusted Nutrient) if this vegetation were treated with an herbicide or managed by the addition of Triploid Grass Carp (*Ctenopharyngodon idella*). The table also shows the result of a model that calculates the potential algae, as chlorophyll a (Adjusted Chlorophyll), which could develop due to the additional nutrients held within the plant biomass. While it would not be expected that all the vegetation would be turned into available phosphorus by these management methods, the data is useful when planning various management activities. Approximately 6.00 % of the lake has submerged vegetation present (PAC) and this vegetation represents about 2.38 % of the available lake volume (PVI). Please see additional parameters for adjusted values where appropriate in Table 8. The vegetation holds only a negligible amount of nutrients (0.03 μg/L of phosphorus and 0.42 μg/L of nitrogen) and no change in the algal growth potential within the lake exists from the loss of nutrients (since little submerged vegetation exists).

Josephine Lake is a balanced lake, in terms of limiting nutrient, and an increase in either phosphorus or nitrogen could change the TSI and increase the potential for algal growth.

Table 8. Field parameters and calculations used to determine nutrients held in Submerged Aquatic Vegetation (SAV) biomass.

Parameter	Value
% Area Covered (PAC)	6.0 %
PVI	2.4 %
Total Phosphorus - Adjusted (ug/L)	0.03
Total Phosphorus - Combined (ug/L)	79.03
Total Nitrogen - Adjusted (ug/L)	0.42
Total Nitrogen - Combined (ug/L)	970.42
Chlorophyll - Adjusted from Total Nutrients (ug/L)	0.00
Chlorophyll - Combined (ug/L)	55.10
Adjusted Chlorophyll TSI	74
Adjusted Phosphorus TSI	62
Adjusted Nitrogen TSI	55
Adjusted TSI (for N, P, and CHLA)	66
Impaired TSI for Lake	60

The lake has little submerged vegetation and only a minor portion of the nutrients available to the lake are contained within the vegetative biomass. Vegetation does not control nutrient availability and does not play a major role in this lake.

Table 9 contains the field data taken in the center of the lake using a multi-probe (we use either a YSI 6000 or a Eureka Manta) which has the ability to directly measure the temperature, pH, dissolved oxygen (DO), percent DO (calculated from DO, temperature and conductivity). These data are listed for three levels in the lake and twice for the surface measurement. The duplicate surface measurement is taken as a quality assurance check on measured data.

Table 9. Water Chemistry Data Based on Manta Water Chemistry Probe for Josephine Lake

Sample Location	Sample Depth (m)	Time	Temp (deg C)	Conductivity (mS/cm3)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	pH
Surface	0.63	7/8/2010 9:30:00 AM	28.83	0.170	93.48	7.36	6.60
Middle	1.99	7/8/2010 9:35:00 AM	27.63	0.168	61.74	4.96	6.41
Bottom	3.69	7/8/2010 9:40:00 AM	25.58	0.230	30.70	2.56	6.56
Mean Value	2.10	7/8/2010 9:45:00 AM	27.34	0.189	61.97	4.96	6.52

Table 9 indicates that the lake is mixed from top to bottom but even with mixing, the water contains little dissolved oxygen at the bottom. The surface dissolved oxygen indicates high productivity probably due to algal formation and activity while the bottom dissolved oxygen indicates a reductive bottom layer (possibly due to high bacterial activity). This is typical for highly colored lakes where sun penetration is limited by color and production of oxygen by plants is limited.

To better understand many of the terms used in this report, we recommend that the reader visit the Hillsborough County & City of Tampa Water Atlas and explore the “Learn More” areas which are found on the resource pages. Additional information can also be found using the Digital Library on the Water Atlas website.

Section 4: Conclusion

Josephine Lake is a medium area (48.29-acre) lake that would be considered in the Eutrophic category of lakes based on water chemistry. It has a plant diversity of 67 species relative to the total watershed plant diversity of 178 species with about 6.00 % percent of the open water areas containing submerged aquatic vegetation. Vegetation helps to maintain the nutrient balance in the lake as well as provide good fish habitat. The lake has many open water areas to support various types of recreation and has a fair diversity of plant species. The primary pest plants in the lake include Eichornia crassipes, Nymphoides cristata, Salvinia minima, Scirpus cubensis, Alternanthera philoxeroides, Ludwigia peruviana, Melaleuca quinquenervia, Panicum repens.

The lake vegetative assessment also may be used to calculate a Lake Vegetative Index (LVI) for the lake (See Note 4). An LVI assessment was not conducted this year on your lake; however, it will be scheduled for the next cycle.

This assessment was accomplished to assist lake property owners to better understand and manage their lakes. Hillsborough County supports this effort as part of their Lake Management Program (LaMP) and has developed guidelines for lake property owner groups to join the LaMP and receive specific assistance from the County in the management of their lake. For additional information and recent updates please visit the Hillsborough County & City of Tampa Water Atlas website.

The LAKEWATCH volunteer for this lake has been consistent in sampling the lake and has provided critical information which allowed us to complete this lake assessment.

Lake Assessment Notes

1. The trophic state index is used by the Water Atlas to provide the public with an estimate of their lake resource quality. A "Good" quality lake is one that meets all lake use criteria (swimmable, fishable and supports healthy habitat). Based on the discussion above, lakes that are in the oligotrophic through low eutrophic range, for the most part, meet these criteria. A trophic state below 60 indicates lakes in this range and these lakes are given the "Good" descriptor. A trophic state above 60 but below 70 can be considered highly productive and a reasonable lake for fishing and most water sports. This lake is considered "Fair", while a lake in the Hypereutrophic range with a TSI greater than 70 will probably not meet the lake use criteria and these lakes are considered to be poor. Please see Table 10 below.

Table 10. Comparison of Classification Schemes

Trophic State Index	Trophic State Classification	Water Quality
0 – 59	Oligotrophic through Mid-Eutrophic	Good
60 – 69	Mid-Eutrophic through Eutrophic	Fair
70 – 100	Hypereutrophic	Poor

Also see the Florida LAKEWATCH publication, "Trophic State: A Waterbody's Ability to Support Plants Fish and Wildlife" and the Trophic State Index Learn More page on the Hillsborough County & City of Tampa Water Atlas.

In recent years FDEP staff have encountered problems interpreting Secchi depth data in many tannic (tea or coffee-colored) waterbodies where transparency is often reduced due to naturally-occurring dissolved organic matter in the water. As a result, Secchi depth has been dropped as an indicator in FDEP's recent TSI calculations (1996 Water-Quality Assessment for The State of Florida Section 305(b) Main Report). This modification for black water TSI calculation has also been adopted by the Water Atlas.

Also, according to Florida LAKEWATCH use of the TSI is often misinterpreted and/or misused from its original purpose, which is simply to describe biological productivity. It is not meant to rate a lake's water quality. For example, higher TSI values represent lakes that support an abundance of algae, plants and wildlife. If you love to fish, this type of lake would not be considered to have "poor" water quality. However, if you are a swimmer or water skier, you might prefer a lake with lower TSI values.

The trophic state index is one of several methods used to describe the biological productivity of a waterbody. Two scientists, Forsberg and Ryding, 1980, developed another method that is widely used. It's known as the Trophic State Classification System. Using this method, waterbodies can be grouped into one of four categories, called trophic states:

Oligotrophic (oh-lig-oh-TROH-fik) where waterbodies have the lowest level of productivity;

Mesotrophic (mees-oh-TROH-fik) where waterbodies have a moderate level of biological productivity;

Eutrophic (you-TROH-fik) where waterbodies have a high level of biological productivity;

Hypereutrophic (HI-per-you-TROH-fik) where waterbodies have the highest level of biological productivity. The trophic state of a waterbody can also affect its use or perceived utility. Figure 9 illustrates this concept.

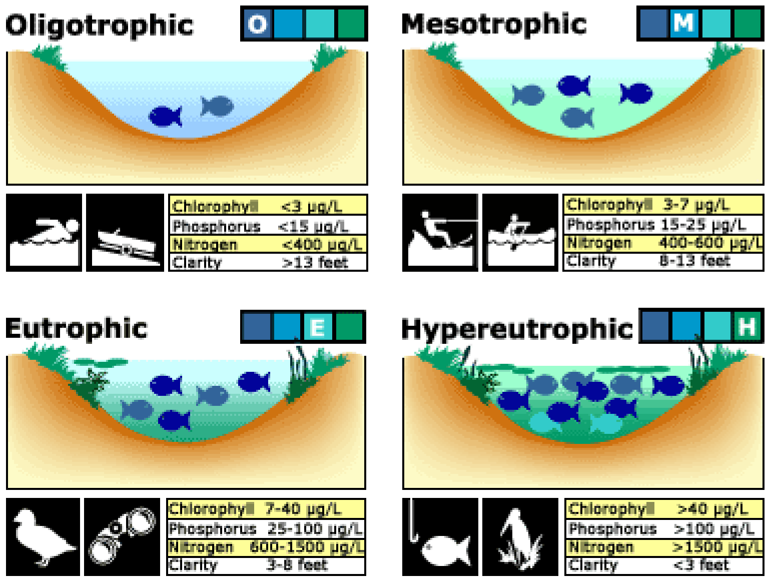
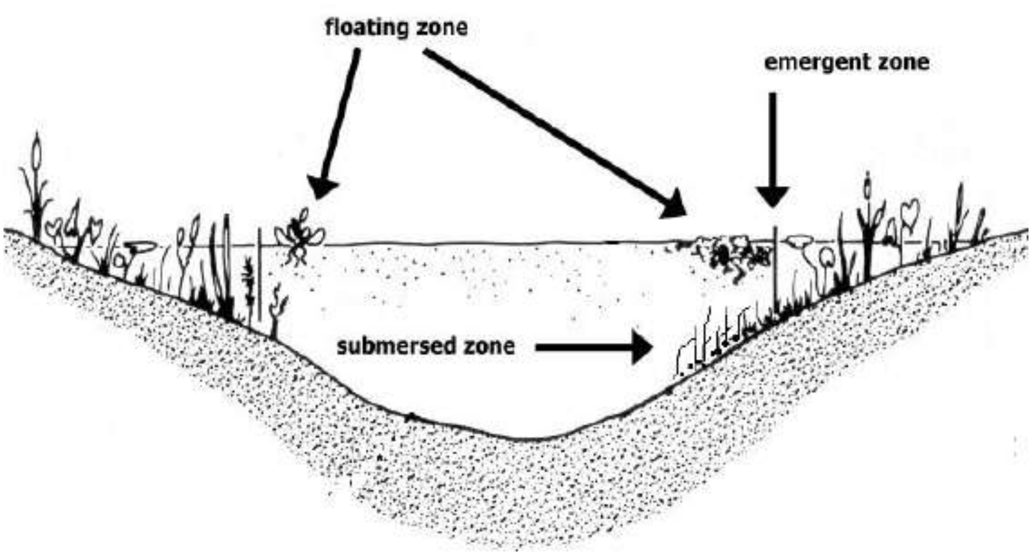


Figure 9. Tropic States

2. **Wide Area Augmentation System** (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. The geostationary satellites broadcast the information to all WAAS-capable GPS receivers. The receiver decodes the signal to provide real time correction of raw GPS satellite signals also received by the unit. WAAS-enabled GPS is not as accurate as standard DGPS which employs close by ground stations for correction, however; it was shown to be a good substitute when used for this type of mapping application. Data comparisons were conducted with both types of DGPS employed simultaneously and the positional difference was determined to be well within the tolerance established for the project.

3. The three primary aquatic vegetation zones are shown below:



4. 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. Below is a table of LVI scores recorded in Hillsborough County for comparison:

Lake Name	Sample Date	LVI Score
Lake Magdalene	5/26/2005	64
Lake Magdalene	10/20/2005	38
Burrell Lake, off Nebraska in Lutz area. Ambient Monitoring Program	8/4/2005	16
Silver lake just south of Waters between Habana and Himes Avenues, Tampa. Ambient Monitoring Program	7/29/2005	36
Unnamed lake on Forest Hills Drive south of Fletcher Avenue. Ambient Monitoring Program	8/3/2005	34
Hanna Pond, off Hanna Rd in Lutz. Ambient Monitoring Program	7/25/2005	38
Small lake, Lutz, just east pf Livingston. Ambient Monitoring Program	7/22/2005	39
Small lake, Lutz, adj to Lake Keene. Ambient Monitoring Program	8/5/2005	28
Unnamed small lake, Tampa, off Fowler behind University Square Mall. Ambient Monitoring Program	7/19/2005	16
Tiffany Lake, Lutz, north of Whittaker. Ambient Monitoring Program	7/25/2005	40
Cedar Lake, south of Fletcher, Forest Hills. Ambient Monitoring Program	7/22/2005	37
Unnamed small lake behind Natives Nursery, Lutz. Ambient Monitoring Program	8/5/2005	20
Unnamed lake on Curry Road off Livingston, Lutz. Ambient Monitoring Program	7/19/2005	46
Unnamed lake in Lutz. Ambient Monitoring Program	7/20/2005	45
Lake Josephine - HIL538UL	10/12/2006	40
Lake Magdalene - HIL546UL	10/18/2006	40
Starvation Lake - HIL540NL	9/28/2006	48
Egypt Lake - HIL556UL	10/31/2006	34
Unnamed Lake - HIL544UL	9/25/2008	58
Lake Rogers - L63P	7/22/2009	65
Lake Alice/Odessa, profundal zone	8/6/2009	71
Lake Carroll (Center)	7/15/2009	64
Unnamed Small Lake - Z4-SL-3011	7/21/2009	24
Unnamed Small Lake - Z4-SL-3020	7/21/2009	40
Lake Ruth - Z4-SL-3031	7/16/2009	71
Lake Juanita - Z4-SL-3036	7/20/2009	72
Chapman Lake	6/8/2009	42
Island Ford Lake	8/10/2010	50
Lake Magdalene	7/29/2010	56
Lake Stemper	7/13/2010	38
Lake Carroll	7/20/2010	57

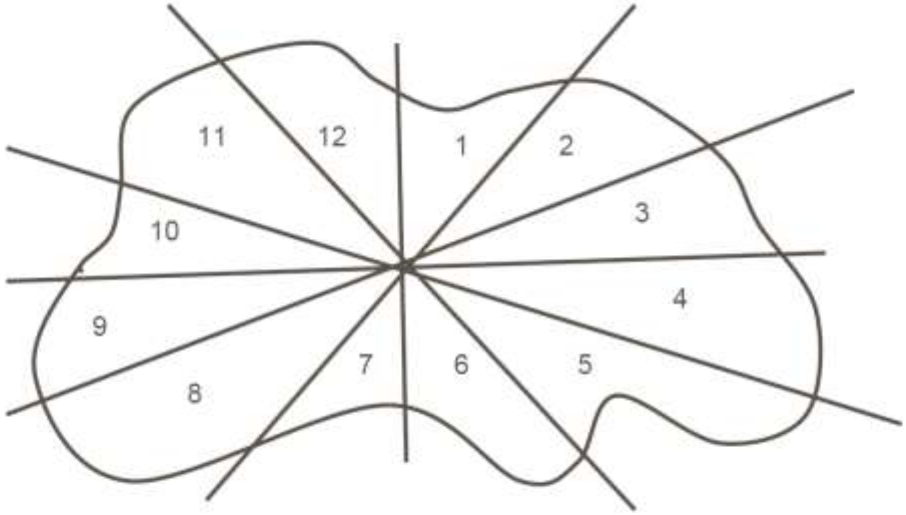
5.

Reference: "Assessing the Biological Condition of Florida Lakes: Development of the Lake Vegetation Index (LVI) Final Report", December, 2007, page 7. Prepared for: Florida Department of Environmental Protection, Twin Towers Office Building, 2600 Blair Stone Road, Tallahassee, FL 32399-2400, Authors: Leska S. Fore*, Russel Frydenborg**, Nijole Wellendorf**, Julie Espy**, Tom Frick**, David Whiting**, Joy Jackson**, and Jessica Patronis**

* Statistical Design

** Florida Department of Environmental Protection

Diagram showing the method used to divide a typical lake into 12 sections for replicate sampling:



6. A lake is **impaired** if: “For the purposes of evaluating nutrient enrichment in lakes, TSIs shall be calculated based on the procedures outlined on pages 86 and 87 of the State’s 1996 305(b) report, which are incorporated by reference. Lakes or lake segments shall be included on the planning list for nutrients if:(1) For lakes with a mean color greater than 40 platinum cobalt units, the annual mean TSI for the lake exceeds 60, unless paleolimnological information indicates the lake was naturally greater than 60, or (2) For lakes with a mean color less than or equal to 40 platinum cobalt units, the annual mean TSI for the lake exceeds 40, unless paleolimnological information indicates the lake was naturally greater than 40, or (3) For any lake, data indicate that annual mean TSIs have increased over the assessment period, as indicated by a positive slope in the means plotted versus time, or the annual mean TSI has increased by more than 10 units over historical values. When evaluating the slope of mean TSIs over time, the Department shall require at least a 5 unit increase in TSI over the assessment period and use a Mann’s one-sided, upper-tail test for trend, as described in Nonparametric Statistical Methods by M. Hollander and D. Wolfe (1999 ed.), pages 376 and 724 (which are incorporated by reference), with a 95% confidence level.”

References: 62-303.352—Nutrients in Lakes. Specific Authority 403.061, 403.067 FS. Law Implemented 403.062, 403.067 FS. History - New 6- 10-02, Amended 12-11-06. Please see page 12 of the Impaired Waters Rule. Updated activity regarding impaired waters may be tracked at: http://www.dep.state.fl.us/water/tmdl/

7. An **adjusted chlorophyll a value** (µg/L) was calculated by modifying the methods of Canfield et al (1983). The total wet weight of plants in the lake (kg) was calculated by multiplying lake surface area (m^2) by PAC (percent area coverage of macrophytes) and multiplying the product by the biomass of submersed plants (kg wet weight m^2) and then by 0.25, the conversion for the 1/4 meter sample cube. The dry weight (kg) of plant material was calculated by multiplying the wet weight of plant material (kg) by 0.08, a factor that represents the average percent dry weight of submersed plants (Canfield and Hoyer, 1992) and then converting to grams. The potential phosphorus concentration (mg/m^3) was calculated by multiplying dry weight (g) by 1.41 mg TP g-1 dry weight, a number that represents the mean phosphorus (mg) content of dried plant material measured in 750 samples from 60 Florida lakes (University of Florida, unpublished data), and then dividing by lake volume (m^3) and then converting to µg/L (1000/1000). From the potential phosphorus concentration, a predicted chlorophyll a concentration was determined from the total phosphorus and chlorophyll a relationship reported by Brown (1997) for 209 Florida lakes. Adjusted chlorophyll a concentrations were then calculated by adding each lake’s measured chlorophyll a concentration to the predicted chlorophyll a concentration.