Lake Assessment Report for
Hanna Lake
in Hillsborough County, Florida

Date Assessed: July 10, 2012
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Reviewed by: Jim Griffin

INTRODUCTION

This assessment was conducted to update existing physical and ecological data for Hanna 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. 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 Photograph of Hanna 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 or a Lowrance HDS5 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.

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[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.

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

Parameter	Feet	Meters	Acres	Acre-Ft	Gallons
Surface Area (sq)	1,482,782	137,755	34.04	0	0
Mean Depth	5	1.50	0	0	0
Maximum Depth	15	4.60	0	0	0
Volume (cubic)	7,065,671	200,078	0	162.20	52,854,890
Gauge (relative)	61.62	18.78	0	0	0
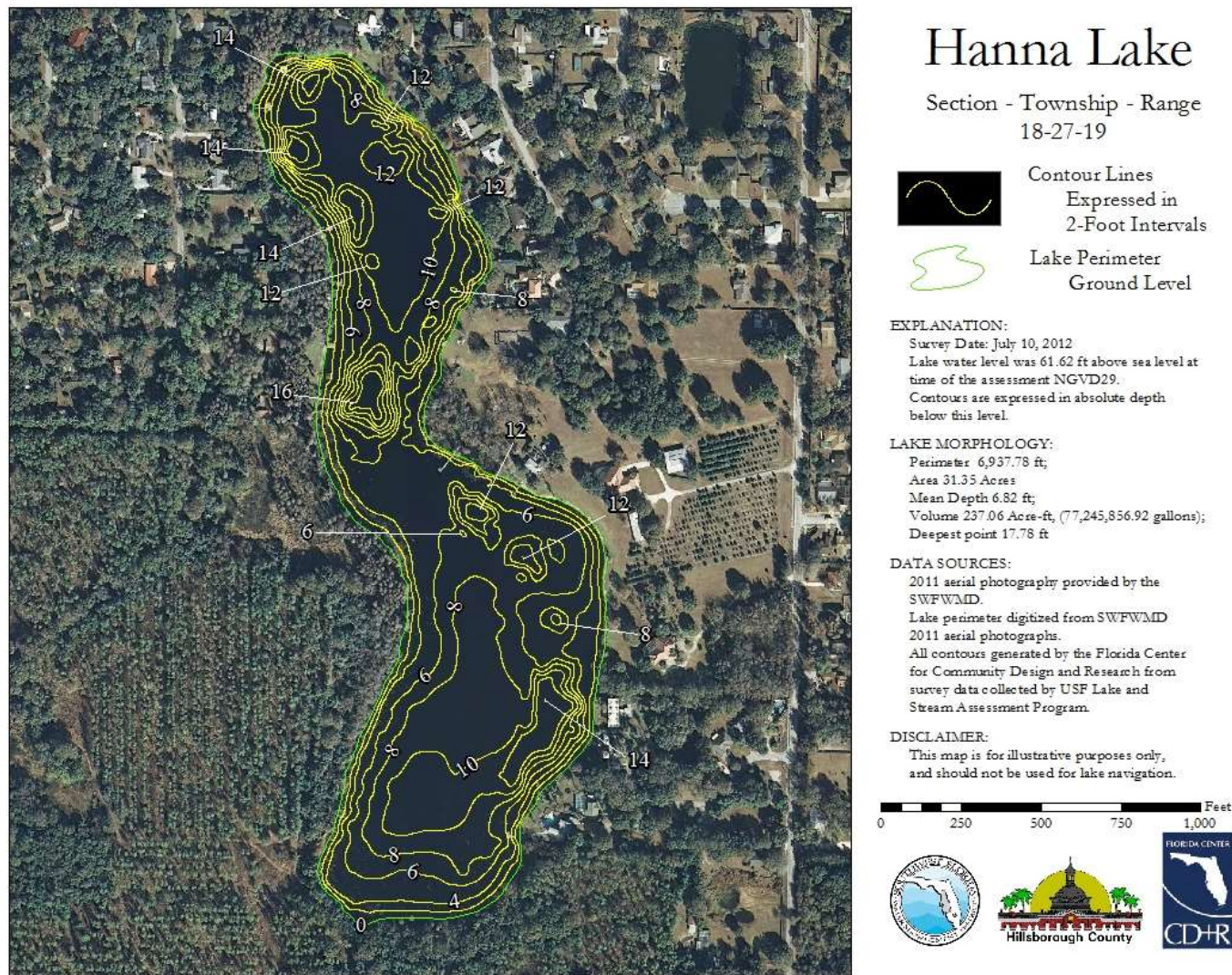
Figure 2. 2-Foot Bathymetric Contour Map for Hanna Lake Created from Data Collected in 2012.

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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 2012 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](#)

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

County and for management of in-lake vegetation outside the wetland fringe (for lakes with an 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	57
Total Plant Diversity (# of Taxa)	59	120
% Non-Native Plants	23	22
Total Pest Plant Species	2	15

Figure 3. Vegetation Assessment Site Map for Hanna Lake

Table 3. List of Floating Leaf Zone Aquatic Plants Found

Plant Species Code	Scientific Name	Common Name	Percent Occurrence	Type
LEN	*Lemna* spp.	Duckweed	100%	N, E0
NLM	*Nuphar advena*	Spatterdock, Yellow Pondlily	100%	N, E0
SMA	*Salvinia minima*	Water Spangles, Water Fern	100%	N, E1
ECS	*Eichhornia crassipes*	Water Hyacinth	10%	E1
NOA	*Nymphaea odorata*	American White Water Lily, Fragrant Water Lily	10%	N, E0

Figure 4. *Nuphar advena*, **Spatterdock, was the most commonly occurring native species of floating leaved vegetation at the time of assessment on Hanna Lake**

Table 4. List of Emergent Zone Aquatic Plants Found

Plant Species Code	Scientific Name	Common Name	Percent Occurrence	Type
APS	*Alternanthera philoxeroides*	Alligator Weed	100%	E2, P
PRS	*Panicum repens*	Torpedo Grass	70%	E1, P
ACE	*Acer rubrum*	Southern Red Maple	60%	N, E0
HYE	*Hydrocotyle umbellata*	Manyflower Marshpennywort, Water Pennywort	60%	N, E0
BMA	*Urochloa mutica*	Para Grass	50%	E1
BOC	*Boehmeria cylindrica*	Bog Hemp, False Nettle	50%	N, E0
CYO	*Cyperus odoratus*	Fragrant Flatsedge	50%	N, E0
DVA	*Diodia virginiana*	Buttonweed	50%	N, E0
EUP	*Eupatorium capillifolium*	Dog Fennel	50%	N, E0
TAS	*Taxodium acendens*	Pond Cypress	50%	N, E0
SSM	*Sapium sebiferum*	Chinese Tallow Tree	40%	E1
EAA	*Eclipta alba*	Yerba De Tajo	40%	N, E0
COS	*Cephalanthus occidentalis*	Buttonbush	40%	N, E0
CCA	*Cinnamomum camphora*	Camphor-tree	40%	N, E1
MEL	*Melaleuca quinquenervia*	Punk Tree, Melaleuca	40%	E1
LLA	*Ludwigia leptocarpa*	Anglestem Primrosewillow	30%	N, E0
LOA	*Ludwigia arcuata*	Piedmont Primrosewillow	30%	N, E0
PFO	*Paederia foetida*	Skunkvine, Stinkvine	30%	E1
PHS	*Polygonum hydropiperoides*	Mild Waterpepper; Swamp Smartweed	30%	N, E0
SCA	*Salix caroliniana*	Carolina Willow	30%	N, E0
SCS	*Oxycaryum cubense*	Burhead Sedge,Cuban Scirpus	20%	N, E0
ICE	*Ilex cassine*	Dahoon Holly	20%	N, E0
WAX	*Myrica cerifera*	Wax Myrtle	20%	N, E0
PNA	*Phyla nodiflora*	Frog-fruit, Carpetweed, Turkey Tangle Fogfruit	20%	N, E0
QLA	*Quercus laurifolia*	Laurel Oak; Diamond Oak	20%	N, E0
LPA	*Ludwigia peruviana*	Peruvian Primrosewillow	20%	E1
CAA	*Centella asiatica*	Asian Pennywort, Coinwort	20%	N, E0
BLS	*Blechnum serrulatum*	Swamp fern, Toothed Midsorus Fern	20%	N
DBA	*Dioscorea bulbifera*	Air Potato	20%	E1
CPT	*Cyperus polystachyos*	Flat Sedge	10%	N, E0
FSC	*Fuirena* spp.	Rush Fuirena	10%	N, E0
AAA	*Ampelopsis arborea*	Peppervine	10%	N, E0
BAA	*Bidens alba*	White Beggar-ticks, Romerillo	10%	N, E0
CLA	*Casuarina equisetifolia*	Australian Pine	10%	E1
COM	*Commelina* spp.	Dayflower	10%	N, E0

Plant Species Code	Scientific Name	Common Name	Percent Occurrence	Type
LRS	*Ludwigia repens*	Creeping Primrosewillow, Red Ludwigia	10%	N, E0
NEA	*Nephrolepis exaltata*	Sword Fern, Wild Boston Fern	10%	N, E0
PBA	*Persea borbonia*	Redbay	10%	N, E0
LOS	*Ludwigia octovalvis*	Mexican Primrosewillow, Long-stalked Ludwigia	10%	N, E0
IAC	*Ipomea cairica*	Mile-A-Minute Vine	10%	E0
QNA	*Quercus nigra*	Water Oak	10%	N, E0
RBA	*Ruellia simplex*	Britton's Wild Petunia	10%	E1
SAM	*Sambucus nigra var. canadensis*	Elderberry	10%	N, E0
PQA	*Parthenocissus quinquefolia*	Virginia Creeper, Woodbine	10%	N, E0
PIN	*Pinus* spp.	Pine Tree	10%	N, E0
UAA	*Ulmus americana*	American Elm; Florida Elm	10%	N, E0
VRA	*Vitis rotundifolia*	Muscandine Grape	10%	N, E0
STS	*Schinus terebinthifolius*	Brazilian Pepper	10%	E1

Figure 5. Photograph of the typical emergent vegetation communities found on Hanna Lake

Table 5. List of Submerged Zone Aquatic Plants Found.

Plant Species Code	Scientific Name	Common Name	Percent Occurrence	Type
NGS	*Najas guadalupensis*	Southern Naiad	90%	N, E0
EBI	*Eleocharis baldwinii*	Baldwin's Spikerush, Roadgrass	50%	N, E0
BMI	*Bacopa monnieri*	Common Bacopa	30%	N, E0
NIT	*Nitella* spp.	Stonewort	20%	N, E0
VAA	*Vallisneria americana*	Tapegrass	10%	N, E0
MGM	*Micranthemum glomeratum*	Manatee Mudflower, Baby's Tears	10%	N, E0

Figure 6. USF-FCCDR staff conducting submerged vegetation biomass sampling on Hanna Lake.

Table 6. List of All Plants and Sample Sites

Plant Common Name	Found at Sample Sites	Percent Occurrence	Growth Type
Alligator Weed	1,2,3,4,5,6,7,8,9,10	100	Emergent
Duckweed	1,2,3,4,5,6,7,8,9,10	100	Floating
Spatterdock, Yellow Pondlily	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
Southern Naiad	1,2,3,4,5,6,7,8,10	90	Submersed
Torpedo Grass	1,3,4,5,6,8,10	70	Emergent
Manyflower Marshpennywort, Water Pennywort	1,2,3,4,5,10	60	Emergent
Southern Red Maple	2,4,6,7,9,10	60	Emergent
Baldwin's Spikerush, Roadgrass	3,4,6,8,10	50	Submersed
Bog Hemp, False Nettle	2,6,7,8,9	50	Emergent
Buttonweed	1,3,4,5,10	50	Emergent
Dog Fennel	4,5,6,8,9	50	Emergent
Fragrant Flatsedge	3,4,6,8,10	50	Emergent
Para Grass	2,3,4,5,9	50	Emergent
Pond Cypress	2,3,5,6,10	50	Emergent
Buttonbush	2,6,7,9	40	Emergent
Camphor-tree	5,8,9,10	40	Emergent
Chinese Tallow Tree	7,8,9,10	40	Emergent
Punk Tree, Melaleuca	4,5,6,9	40	Emergent
Yerba De Tajo	2,4,5,8	40	Emergent
Anglestem Primrosewillow	2,3,6	30	Emergent
Carolina Willow	2,6,9	30	Emergent
Common Bacopa	4,5,10	30	Submersed
Mild Waterpepper; Swamp Smartweed	2,8,10	30	Emergent
Piedmont Primrosewillow	1,3,10	30	Emergent
Skunkvine, Stinkvine	2,5,8	30	Terrestrial
Air Potato	7,8	20	Emergent
Asian Pennywort, Coinwort	1,4	20	Emergent
Burhead Sedge,Cuban Scirpus	1,2	20	Emergent
Dahoon Holly	6,7	20	Emergent
Frog-fruit, Carpetweed, Turkey Tangle Fogfruit	5,10	20	Emergent
Laurel Oak; Diamond Oak	4,7	20	Emergent

Plant Common Name	Found at Sample Sites	Percent Occurrence	Growth Type
Peruvian Primrosewillow	1,4	20	Emergent
Stonewort	4,8	20	Submersed
Swamp fern, Toothed Midsorus Fern	8,9	20	Emergent
Wax Myrtle	4,7	20	Emergent
American Elm; Florida Elm	4	10	Emergent
American White Water Lily, Fragrant Water Lily	3	10	Floating
Australian Pine	8	10	Emergent
Brazilian Pepper	2	10	Emergent
Britton's Wild Petunia	5	10	Terrestrial
Creeping Primrosewillow, Red Ludwigia	5	10	Emergent
Dayflower	4	10	Emergent
Elderberry	9	10	Emergent
Flat Sedge	5	10	Emergent
Manatee Mudflower, Baby's Tears	5	10	Submersed
Mexican Primrosewillow, Long-stalked Ludwigia	6	10	Emergent
Mile-A-Minute Vine	8	10	Emergent
Muscandine Grape	9	10	Emergent
Peppervine	6	10	Emergent
Pine Tree	4	10	Emergent
Redbay	5	10	Emergent
Rush Fuirena	3	10	Emergent
Sword Fern, Wild Boston Fern	8	10	Terrestrial
Tapegrass	8	10	Submersed
Virginia Creeper, Woodbine	5	10	Emergent
Water Hyacinth	2	10	Floating
Water Oak	4	10	Emergent
White Beggar-ticks, Romerillo	1	10	Terrestrial

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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 Hanna Lake Water Quality Page can be viewed at http://www.hillsborough.wateratlas.usf.edu/lake/waterquality.asp?wbodyid=5346&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. Hanna Lake does not have an active LAKEWATCH volunteer presently. The last LAKEWATCH volunteer water chemistry data was collected on December 5, 2000, so only limited trend analysis is possible. 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 7Figure 7, Figure 8, and Figure 9 for Hanna 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, Hanna Lake has a color value determined as a platinum cobalt unit (pcu) value of 54.45 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. Hanna Lake has a TSI of 62 and meets the FDEP Impaired Waters Rule (IWR) criteria and could be classified as impaired. See also Table 8.

On November 30, 2012, the U.S. Environmental Protection Agency (EPA) approved State standards for the prevention of nutrient pollution in Florida's waterways applicable to 100% of Florida's rivers, streams, lakes and to estuaries from Tampa Bay to Biscayne Bay, including the Florida Keys. These standards are called numeric nutrient criteria (NNC) and establish levels for nitrogen and phosphorus as well as biological conditions that must be met to protect healthy waterways. For lakes, these criteria established a set concentration of nitrogen and phosphorus, based on a not-to-exceed chlorophyll a concentration of 20 µg/L for dark colored and alkaline lakes, and a 6 µg/L for clear, acid lakes. The prior standards used to determine nutrient impairment were based on an estimate of trophic state, and also applied a lake's color and alkalinity as selection criteria as is the case for the new rule. This second standard is still used in part for the 2012 reports and in all the past reports. In the future only the new standards will be used. Because the actual rule was not approved until the end of 2012, we elected to use both the old and new criteria. Please see the discussion on Lake Nutrient Impairment at the end of this report for further explanation.

Table 7 provided the results of an NNC assessment for Lake Hanna, but only based on a limited number of samples. Based on this limited data set and for a colored lake the lake could be listed impaired for chlorophyll a, but the concentrations for phosphorus and nitrogen would be slightly below that required for impairment and the lake would not be listed as impaired for these nutrients. FDEP has not listed or evaluated the lake so there is no official listing at this time.
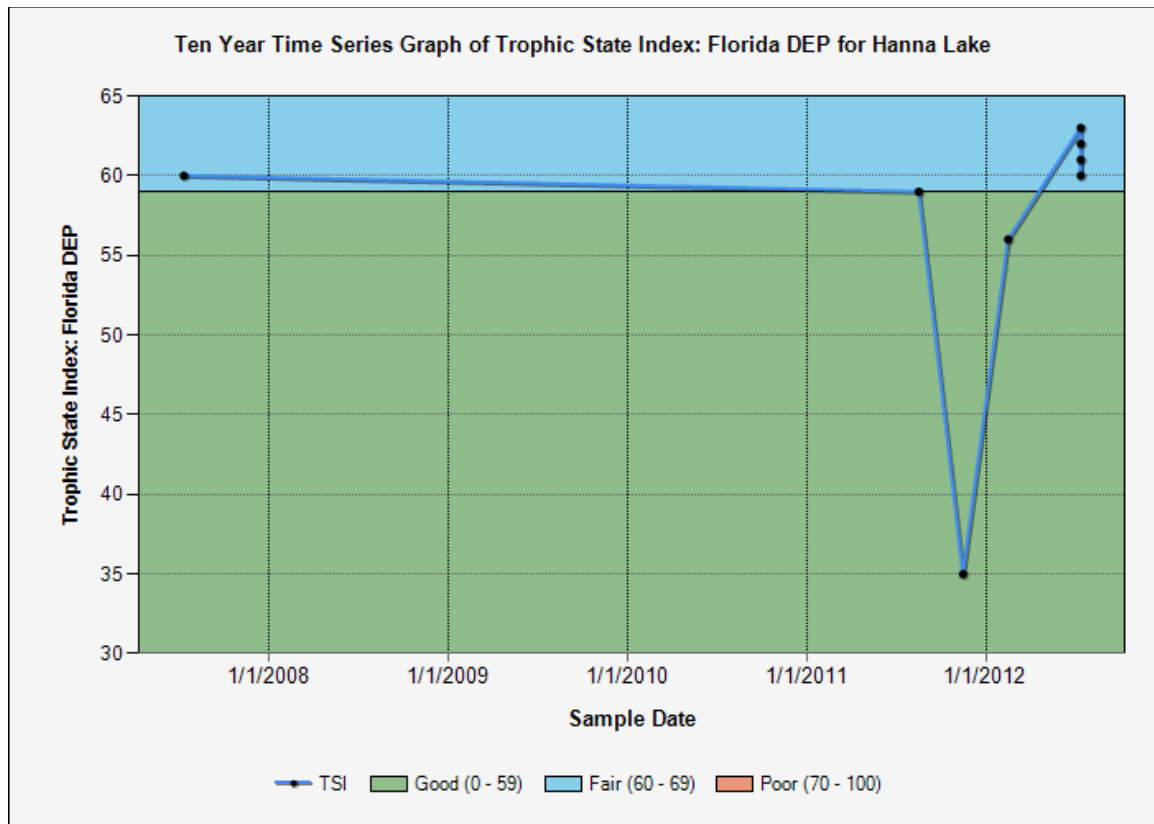
Figure 7. Recent Trophic State Index (TSI) graph for Hanna Lake[vi]

[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=5346&data=TSI&datatype=WQ&waterbodyatlas=lake&ny=10&bench=1

Table 7. Numeric Nutrient Criteria evaluation for East Lake (see NNC table in Lake Assessment Note 3 at end of report)

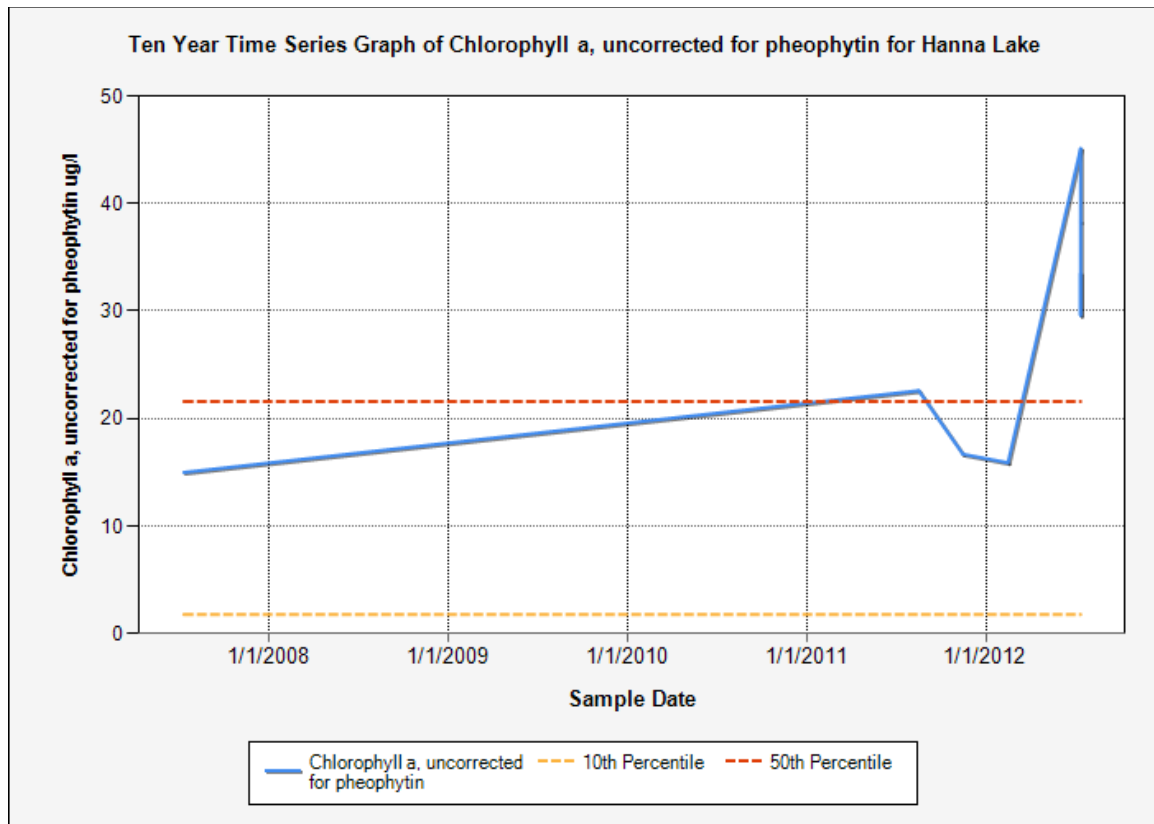| Lake	Hanna Lake
Geometric Mean, Color (pcu*)	54.27
Number of Samples, Color	8
Geometric Mean, Specific Conductance (µmhos)	Unknown
Number of Samples, Specific Conductance	0
Lake Type (based on Color, Specific Conductance)	Colored
Chlorophyll a (Chla) Criterion (µg/L)	≤ 20
P Criterion #1 (mg/L) (To be applied if sufficient Number of Samples for Geometric Mean of Chla AND Chla Geometric Mean meets Chla Criterion)	0.05-0.16
P Criterion #2 (mg/L) (To be applied if insufficient Number of Samples for Geometric Mean of Chla, OR if Chla Geometric Mean does not meet Chla Criterion)	≤ 0.05
N Criterion #1 (mg/L) (To be applied if sufficient Number of Samples for Geometric Mean of Chla AND Chla Geometric Mean meets Chla Criterion)	1.27-2.23
N Criterion #2 (mg/L) (To be applied if insufficient Number of Samples for Geometric mean of Chla, OR if Chla Geometric Mean does not meet Chla Criterion)	≤ 1.27
Geometric Mean, Chla (µg/L)	36.177
Geometric Mean, TP (mg/L)	0.048
Geometric Mean, TN (mg/L)	1.115
Number of Samples, Chla, TP, and TN	4
Potential Impairment, Chlorophyll a	**Impaired**
Potential Impairment, TP	**Not Impaired**
Potential Impairment, TN	**Not Impaired**

*Platinum Cobalt Units

Figure 8. Recent Chlorophyll a graph for Hanna 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=5346&data=Chla_u
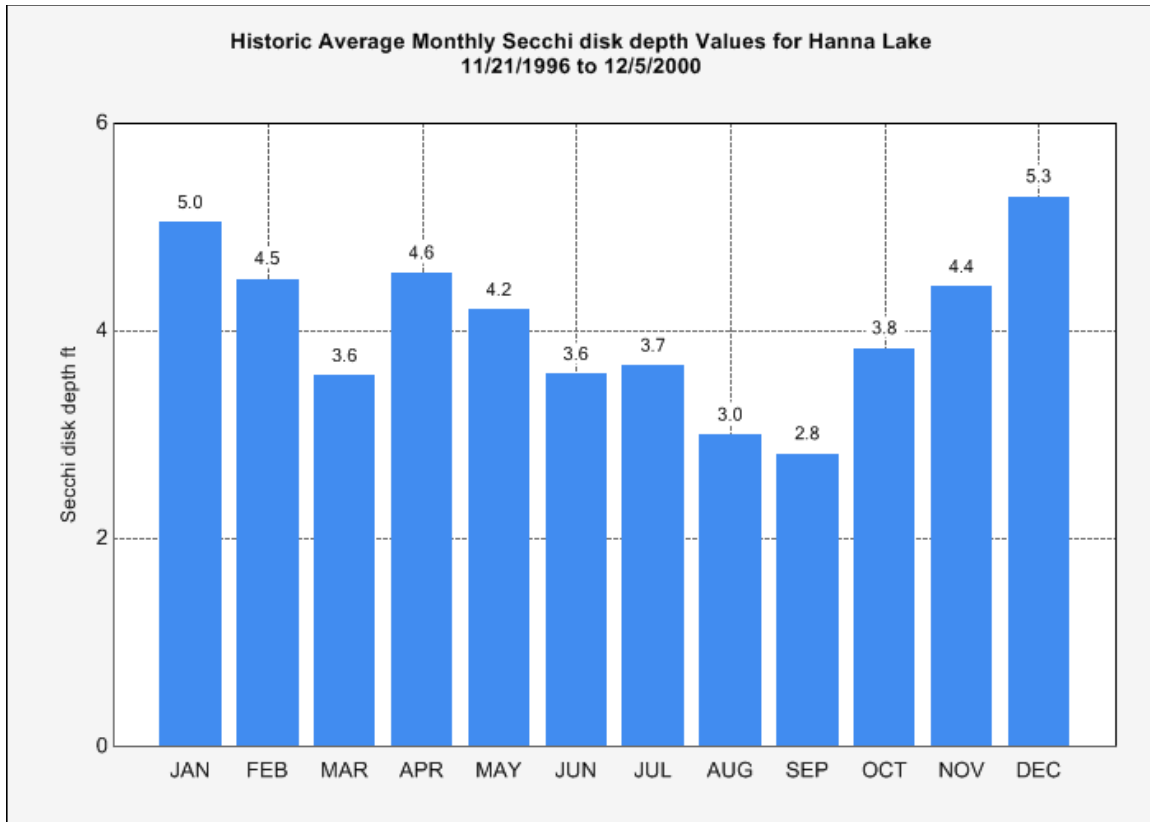gl&datatype=WQ&waterbodyatlas=lake&ny=10&bench=1

Figure 9. Recent Secchi Disk graph for Hanna Lake was not available due to limited data. As a substitute a graph of historical monthly average secchi disk values has been provided.[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 8 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=5346&data=secchi_ft&datatype=WQ&waterbodyatlas=lake&ny=10&bench=1

Table 8. Water Quality Parameters (Laboratory) for Hanna Lake. Value column provides the data based on lake assessment sampling. Mean Value is based on long-term sample values for the lake.

Parameter	Value	Mean Value
Lake Area (Acres)	34.04	
Lake Area (m2)	137,755.00	
Lake Volume (m3)	200,078.00	
Number of Vegetation Sites	10	
Average Station SAV Weight	0.17	
Wet Weight of Vegetation (g)	5,449,585.89	
Dry Weight of Vegetation (g)	435,966.87	
Total Phosphorus (µg/L)	48.50	28.16
Total Nitrogen (µg/L)	1115.00	921.40
Chlorophyll a (µg/L)	36.63	18.66
TN/TP	23.0	32.7
Limiting Nutrient	Balanced	Phosphorus
Chlorophyll TSI	68	58
Phosphorus TSI	53	54
Nitrogen TSI	58	54
TSI	62	56
Color (PCU)	54.45	54.45
Secchi disk depth (ft)	2.50	4.19
Impaired TSI for Lake	60	60
Lake Status (Water Column)	Impaired	Not 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" systems 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 8 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.

Both phosphorous and nitrogen concentrations at the time of the assessment were higher than historical values. Phosphorous was elevated to an extent that it is no longer the limiting nutrient to algal growth. As a result, elevated levels of chlorophyll were seen as well as a resulting decrease in Secchi disk values. The end result of the elevated nutrients is the classification of impairment of Hanna Lake based on the TSI value.

Table 9 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 23.00 % of the lake has submerged vegetation present (PAC) and this vegetation represents about 2.21 % of the available lake volume (PVI). Please see additional parameters for adjusted values where appropriate in Table 9. The vegetation holds enough nutrients to add about 3.07 µg/L of phosphorus and 41.4 µg/L of nitrogen to the water column and increase the algal growth potential within the lake.

Hanna 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 9. Field parameters and calculations used to determine nutrients held in Submerged Aquatic Vegetation (SAV) biomass.

Parameter	Value	Mean Value
% Area Covered (PAC)	23.0 %	
PVI	2.2 %	
Lake Vegetation Index	41	
Total Phosphorus - Adjusted (µg/L)	3.07	
Total Phosphorus - Combined (µg/L)	51.57	
Total Nitrogen - Adjusted (µg/L)	41.40	
Total Nitrogen - Combined (µg/L)	1156.4	
Chlorophyll - Adjusted from Total Nutrients (µg/L)	0.73	
Chlorophyll - Combined (µg/L)	37.36	
Adjusted Chlorophyll TSI	68	
Adjusted Phosphorus TSI	54	
Adjusted Nitrogen TSI	58	
Adjusted TSI (for N, P, and CHLA)	62	
Impaired TSI for Lake	60	60

Table 10 contains the field data taken in the center of the lake using a multi-probe (we use 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 (surface, middle and bottom) and for each LVI section in the lake.

Table 10. Water Chemistry Data Based on Manta Water Chemistry Probe for Hanna Lake

Sample Location	Sample Depth (m)	Time	Temp (deg C)	Conductivity (mS/cm3)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	pH
Bottom - 1	3.84	7/12/2012 12:00:00 AM	29.13	0.198	31.02	2.42	6.37
Bottom - 2	1.67	7/12/2012 12:00:00 AM	29.49	0.190	53.45	4.15	6.48
Bottom - 3	2.12	7/12/2012 12:00:00 AM	29.50	0.188	62.51	4.86	6.56
Bottom - 4	2.91	7/12/2012 12:00:00 AM	29.35	0.189	61.76	4.81	6.66
Middle - 2	1.00	7/12/2012 12:00:00 AM	29.94	0.191	64.34	4.96	6.48
Middle - 3	1.32	7/12/2012 12:00:00 AM	29.86	0.188	73.85	5.70	6.58
Middle - 4	1.76	7/12/2012 12:00:00 AM	29.55	0.188	67.95	5.28	6.58
Middle -1	2.20	7/12/2012 12:00:00 AM	29.54	0.191	50.54	3.92	6.42
Surface - 1	0.80	7/12/2012 12:00:00 AM	30.82	0.191	77.85	5.91	6.46
Surface - 2	0.05	7/12/2012 12:00:00 AM	31.57	0.190	73.37	5.50	6.47
Surface - 3	0.55	7/12/2012 12:00:00 AM	31.89	0.190	87.48	6.53	6.58
Surface - 4	0.67	7/12/2012 12:00:00 AM	31.77	0.189	96.32	7.21	6.68

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

Hanna Lake is a medium area (34.04-acre) lake that would be considered in the Eutrophic category of lakes based on water chemistry. It has a plant diversity of 59 species relative to the total watershed plant diversity of 120 species with about 23.00 % 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 good diversity of plant species. The primary pest plants in the lake include Alternanthera philoxeroides and Panicum repens.

The lake vegetative assessment also was used to calculate a Lake Vegetative Index (LVI) for the lake (See Note 4). The LVI can be used to help determine if a lake is impaired in terms of types and quantities of vegetation found in and along the lake shore. An LVI threshold of 37 is used by FDEP to establish a point below which the lake could be considered heavily disturbed and possibly impaired. This threshold is intended to assist the analyst in classifying a lake as impaired when used with water quality data. For example, a clear water lake may have a TSI of 42 but have an LVI of 70. Since the LVI is significantly above the threshold and indicates low human disturbance, the analyst might declare the lake unimpaired even with a TSI slightly above the water quality threshold for a clear lake. Hanna Lake has an LVI of 41 and would be considered not impaired based on LVI alone.

By the lake nutrient impairment standards in place prior to November 2012 a clear water lake would require a TSI of 40 or below to not be considered impaired and if a dark water lake it would require a TSI of 60 or below to not be considered impaired. Hanna Lake is a dark water lake and has a TSI of 62. By the new numeric nutrient standards if the lake is clear and acid then it must have chlorophyll *a* concentration of less than or equal to 6 µg/L and meet certain nitrogen and phosphorous concentration limitations and if a dark lake or an alkaline lake then it must have a chlorophyll *a* concentration below 20 µg/L and meet certain nitrogen and phosphorous concentration limitations. Hanna Lake has chlorophyll *a* concentration of 36 µg/L. and would be considered impaired for chlorophyll a by the new criteria. It would also be considered impaired by the criteria in place prior to November 2012. Submerged vegetation holds only a small percentage of available nutrients; however if it were to be released to the water column it could change the nutrient concentration by an amount that would make the lake also impaired for phosphorous and nitrogen. The lake has not been studied or listed by FDEP so no official statement of impairment is available. See discussion and table for NNC at the end of this report.

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.

Lake Assessment Notes

1. Trophic State Index

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 **Error! Reference source not found.** below.

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 10 illustrates this concept.
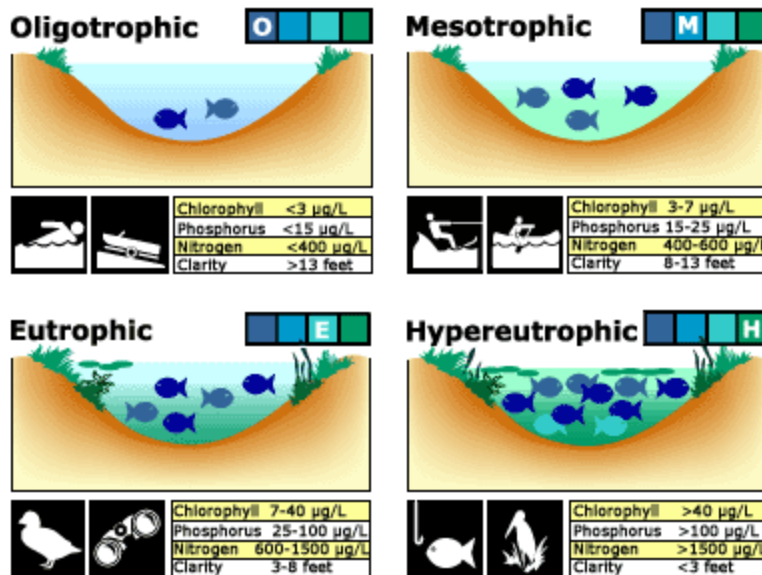
Figure 10. Tropic States

2. **Rule for Lake Nutrient Impairment prior to November 30, 2012**: "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 F.A.C —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/

3. **New Numeric Nutrient Criteria in effect after November 30, 2012:** The following excerpt from the Florida Administrative Code (F.A.C.) Surface Water Quality Standard (62-302.531(b)-1) is provided as reference for the numeric nutrient criteria that will be used in all Lake Reports.

"For lakes, the applicable numeric interpretations of the narrative nutrient criterion in paragraph 62-302.530(47)(b), F.A.C., for chlorophyll *a* are shown in the table below. The applicable interpretations for TN and TP will vary on an annual basis, depending on the availability of chlorophyll *a* data and the concentrations of nutrients and chlorophyll *a* in the lake, as described below. The applicable numeric interpretations for TN, TP, and chlorophyll *a* shall not be exceeded more than once in any consecutive three year period.

a. If there are sufficient data to calculate the annual geometric mean chlorophyll *a* and the mean does not exceed the chlorophyll *a* value for the lake type in the table below, then the TN and TP numeric interpretations for that calendar year shall be the annual geometric means of lake TN and TP samples, subject to the minimum and maximum limits in the table below. However, for lakes with color > 40 PCU in the West Central Nutrient Watershed Region, the maximum TP limit shall be the 0.49 mg/L TP streams threshold for the region; or

b. If there are insufficient data to calculate the annual geometric mean chlorophyll a for a given year or the annual geometric mean chlorophyll a exceeds the values in the table below for the lake type, then the applicable numeric interpretations for TN and TP shall be the minimum values in the table below.

Long Term Geometric Mean Lake Color and Alkalinity	Annual Geometric Mean Chlorophyll *a*	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 CaCO₃	20 µg/L	0.03 mg/L	1.05 mg/L	0.09 mg/L[1]	1.91 mg/L
≤ 40 Platinum Cobalt Units and ≤ 20 mg/L CaCO₃	6 µg/L	0.01 mg/L	0.51 mg/L	0.03 mg/L[1]	0.93 mg/L

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

For the purpose of subparagraph 62-302.531(2)(b)1., F.A.C., color shall be assessed as true color and shall be free from turbidity. Lake color and alkalinity shall be the long-term geometric mean, based on a minimum of ten data points over at least three years with at least one data point in each year. If insufficient alkalinity data are available, long-term geometric mean specific conductance values shall be used, with a value of <100 micromhos/cm used to estimate the 20 mg/L CaCO3 alkalinity concentration until such time that alkalinity data are available."

For Hillsborough County, the Anclote River, Brooker and Rocky Brushy Creek lakes (Direct tributaries to Old Tampa Bay) are the only lake groups not considered West Central Nutrient Regions. Please see the map below of Nutrient Regions for Florida. Those lakes within the West Central nutrient region traditionally have higher background level of phosphorus and the standard is set at the higher 0.49 mg/L standard. All others will need to meet the table standard above.

Table 11. NNC for Lakes based on Lake Type and new rule (November 2012)

| Lake Type/Criteria	Clear_Alk	Clear	Colored
Chlorophyll a Criteria (µg/L)	≤ 20	≤ 6	≤ 20
Sufficient for Geomean & Geomean Chla meets Chla Criteria then P (mg/L)	0.03-0.09	0.01-0.03	0.05-0.16
Insufficient for Geomean or Geomean Chla does not meet Chla Criteria then P (mg/L)	≤ 0.03	≤ 0.01	≤ 0.05
Sufficient for Geomean & Geomean Chla meets Chla Criteria then N (mg/L)	1.05-1.91	0.51-0.93	1.27-2.23
Insufficient for Geomean or Geomean Chla does not meet Chla Criteria then N (mg/L)	≤ 1.05	≤ 0.51	≤ 1.27
Lake Type*:			
Lake Type Clear (Alk LTE 20 mg/L CaCO3 or 100µSeimens/cm or µmhos/cm , Color LTE 40 pcu)			
Lake Type Clear-Alk: (Alk .20 mg/L or >0.100µSeimens/cm or 100 µmhos/cm , Color > 40 pcu)			
Lake Type Colored (Color > 40 pcu)			

*A µmho is equal to 0.001 µS (micro Siemens).
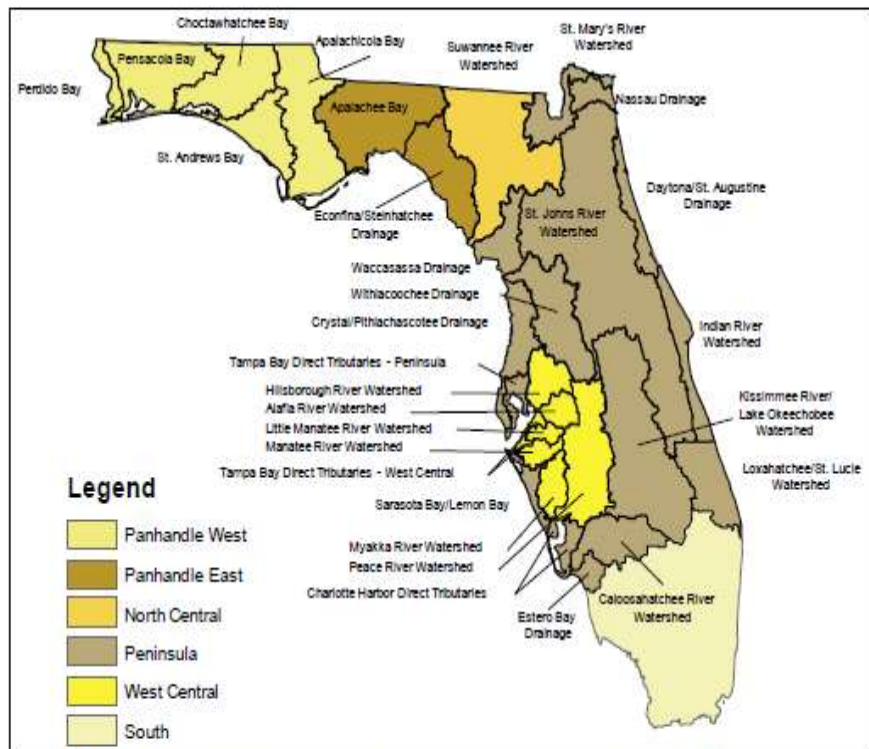
Figure 1-8. Detailed map of EPA's stream classification by NWRs used in final rule. Note that watershed boundaries are delineated by National Oceanic and Atmospheric Administration's (NOAA) Coastal Assessment Framework (CAF) of estuarine drainage areas (EDAs), fluvial drainage areas (FDAs), and coastal drainage areas (CDAs).

4. Lake Vegetation

The three primary aquatic vegetation zones are shown below:
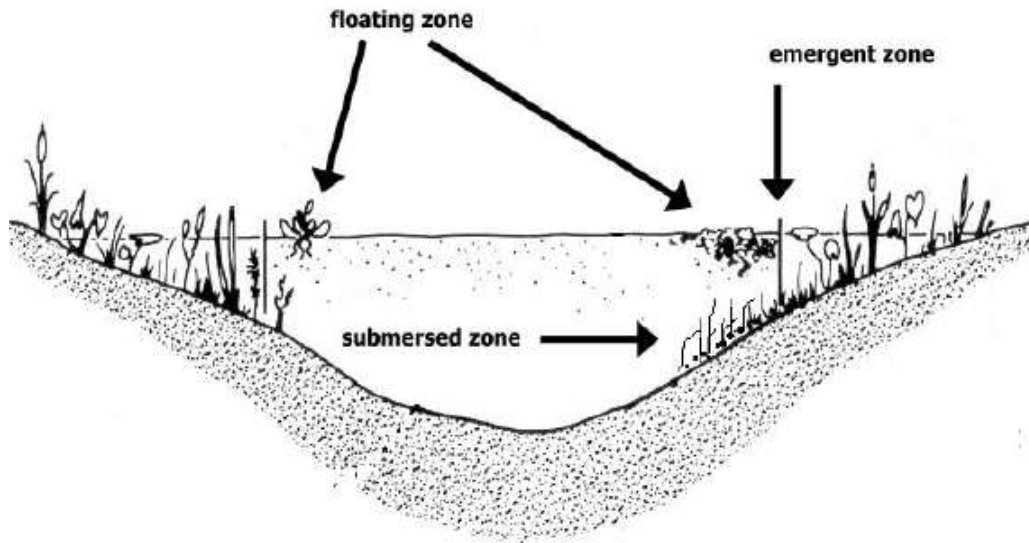
5. **The Lake Vegetation Index (LVI)** is a rapid assessment protocol in which selected sections of a lake are assessed for the presence or absence of vegetation through visual observation and through the use of a submerged vegetation sampling tool called a Frodus. The assessment results provide a list 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

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:
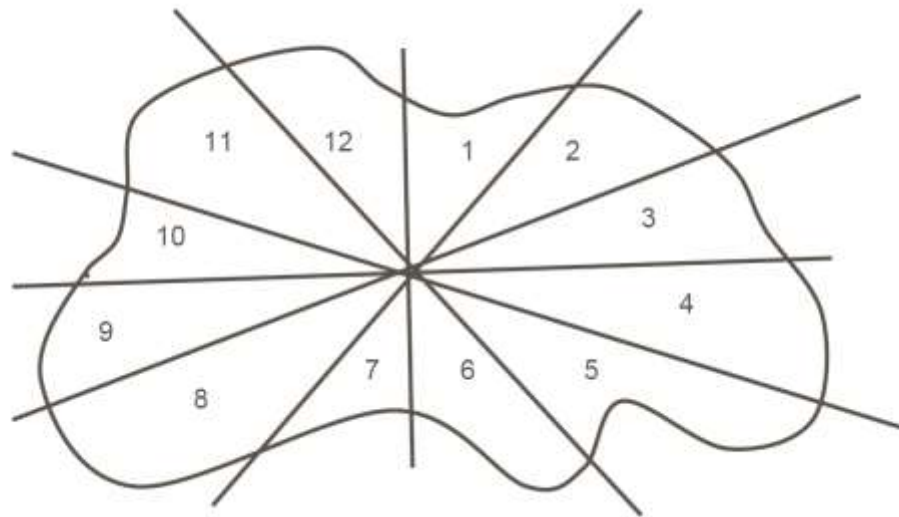
6. Estimating nutrients held in submerged plants

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.