LAKE ECOSUMMARY

Lake Eustis, August 23, 2011

DEP conducted biological sampling on August 23, 2011 at Lake Eustis in conjunction with a statewide probabilistic water quality monitoring program sampling event June 8, 2011 to assess attainment of designated uses. Water quality results met some, but not all applicable limits; the samples met the applicable limits for chlorophyll *a* and total phosphorus, but exceeded the limit for total nitrogen. Plant community data indicated that the lake did not meet expectations for a healthy, well-balanced lake.

Background

Although a healthy, well-balanced lake may be maintained with some level of human disturbance, human activities may result in lake degradation. Human stressors include increased inputs of nutrients, sediments and/or pesticides from watershed runoff, undesirable removal of native shoreline and/or upland buffer vegetation, and introduction of nuisance (generally exotic) plants and animals. DEP has methods to evaluate if human activities have resulted in the condition where a particular waterbody has exceeded water quality criteria (Chapter 62-302, Florida Administrative Code), including whether adverse impacts to biological communities have occurred. DEP water quality standards are designed to protect designated uses of the waters of the state (*e.g.,* recreation, aquatic life support), and exceedances of these standards are associated with interference with the designated use. Chlorophyll *a* is a measure of algal biomass in the water column. In clear, low alkalinity lakes (lakes where color is < 40 PCU and alkalinity is < 20 mg/L $CaCO_2$), a healthy system is expected to have $\leq$ 6 µg/L of chlorophyll *a*. In colored ($\geq$ 40 PCU) lakes or clear, high alkalinity ($\geq$20 mg/L $CaCO_2$) lakes, healthy systems are expected to have $\leq$ 20 µg/L of chlorophyll *a*. Chlorophyll *a* values greater than those shown above may result in unwanted shading of aquatic plants and/or greater potential for harmful algal blooms. The Lake Vegetation Index (LVI) assesses how closely the plant community of a lake resembles a native undisturbed community. These tools are often used in conjunction with one another because it is possible to detect imbalance in the plant community while the algal community appears healthy (and vice versa).

Methods

The DEP Central District Office conducted the LVI and collected field parameter data on this lake on August 23, 2011. The St. Johns River Water Management District (SJRWMD) collected water samples on June 8, 2011. Samples were collected following DEP Standard Operating Procedures (SOPs; see http://www.dep.state.fl.us/water/sas/qa/sops.htm). Sampling and analyses met DEP quality assurance/quality control standards (see http://www.dep.state.fl.us/water /sas/qa/index.htm). For the LVI, species lists were developed for four of twelve sections of the lake (Figure 1), and the following information was derived from those lists: percent native species, percent invasive exotic species, percent sensitive species, and the coefficient of conservatism (C of C; a measure of how tolerant a species is to disturbance) of the dominant species. According to DEP SOP LT 7000, the LVI score ranges and categories are: (78-100) Exceptional; (38-77) Healthy; and (0-37) Impaired. DEP's new draft F.A.C. Chapter 62.302 requires at least two temporally independent LVIs with an average score of 43 or above in order to meet the expectation of a healthy, well balanced community. The LVI was sampled per DEP SOP FS7310 and calculated per DEP SOP LT7000.

Site Information

Lake Eustis, located in Lake County approximately 30 miles northwest of Orlando, is part of the Upper Ocklawaha River Basin. Lake Eustis has a drainage basin of approximately 27,878 acres and has a surface area of approximately 7,757 acres and an average depth of 3.46 m (11.4 ft). Both Lake Dora and Lake Harris discharge into Lake Eustis. Lake Eustis flows into Lake Griffin through Haines Creek.

Using the methodology to identify and verify water quality impairments described in Chapter 62-303, Florida Administrative Code (Identification of Impaired Surface Waters or IWR), Lake Eustis was verified as

impaired by un-ionized ammonia and nutrients, and was included on the verified list of impaired waters for the Ocklawaha Basin that was adopted by Secretarial Order on August 28, 2002.

To reduce pollutants and improve the water body, the Total Maximum Daily Load (TMDL) for total phosphorus (TP) was developed and adopted on September 19, 2003 for Lake Eustis and Haines Creek Reach. The TP target concentration of 0.025 mg/L listed in the TMDL report was based on the data analysis conducted by the SJRWMD (SJRWMD 2004). The SJRWMD publication also lists a guidance target concentration for total nitrogen (TN) of 0.708 mg/L. The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-situ water quality conditions.

To meet the restoration targets specified in the TMDL report, Lake Eustis and Haines Creek were included in the Upper Ocklawaha Basin Management Action Plan (BMAP). The action plan was developed in partnership with cities, counties, the St. Johns River Water Management District, Lake County Water Authority, Florida Department of Transportation, Florida Department of Agriculture and Consumer Services, Florida Fish and Wildlife Conservation Commission and other local stakeholders. The BMAP was adopted on August 14, 2007.

Since 2000, there have been 20 stormwater retrofits completed within this watershed. The estimated TP load reduction from those projects is 450 pounds per year. Most projects were done by the City of Eustis as part of the proactive stormwater management program and FDOT as part of the US 441 roadway improvements. Lake County Public Works have an active Lakeshore Drainage Improvement project for Lake Eustis. They and SJRWMD also have ongoing restoration projects to reduce TP loading into Lake Trout which is a tributary to Lake Eustis. Those projects are expected to remove 1,487 pound/year of TP.

Results

Water Quality

The concentrations of total nitrogen (TN) in the sample collected on June 8, 2011 (1.3 mg/L), exceeded the guidance target concentration of 0.708 mg/L (SJRWMD 2004) and the newly adopted minimum water quality criterion of 1.05 mg/L (note that compliance cannot be determined with a single sample). Total phosphorus (TP) concentration (0.018 mg/L) was below the TMDL limit of 0.025 mg/L, and all other parameters met their applicable limits. Please see Table 1 for other results.

Table 1. Water quality results from surface water samples collected on June 8, 2011 at Lake Eustis by the SJRWMD and physical parameters measured on August 23, 2011 by DEP. Water quality criteria from 62-302, F.A.C.

Analyte	6/8/11 Result	8/23/11 Result	Applicable Class III Water Quality Criteria
Field Temperature (°C)	28.0	31.5	
Field pH (SU)	8.5	8.4	
Field Dissolved Oxygen (mg/L)	7.87	7.5	≥ 5
Field Specific Conductance (µmhos/cm)	388	389	Not to exceed 50% of background or 1275 µmhos/cm
Alkalinity (mg $CaCO_3$/L)	129 A		
Color (PCU)	7.6		
Turbidity (NTU)	3.4		
Chlorophyll a (µg/L)	15		<20**
Total Phosphorus (mg/L)	0.018		<0.025*
Nitrate+Nitrite (mg/L)	0.004 U		
Ammonia (mg/L)	0.023		
Un-ionized Ammonia (mg/L)	0.005 c		<0.02
Total Kjeldahl Nitrogen (mg/L)	1.3		
Total Nitrogen (mg/L)	1.3		< 1.05**
Secchi depth (m)	1		

*Total Maximum Daily Load for Total Phosphorus For Lake Eustis and Haines Creek Reach, Lake County, Florida, September 19, 2003

**proposed 62-302 thresholds for Annual Geometric Mean Total

c – Value calculated

A - Value reported is the mean of two or more determinations

U - Material was analyzed for but not detected. The reported value is the method detection limit for the sample analyzed.

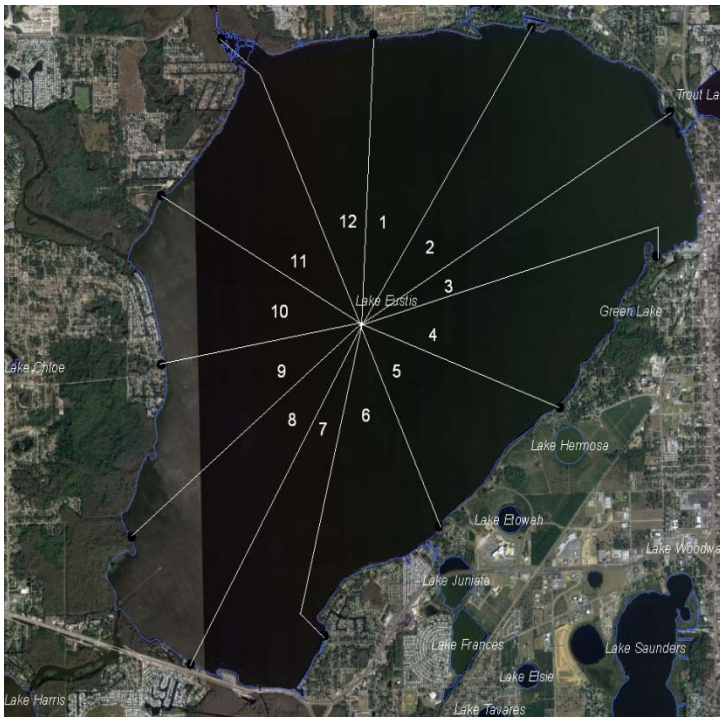

Figure 1. Sampling map of Lake Eustis. Sections 3,12,6, 9 were sampled for the Lake Vegetation Index. The water quality sample was collected from the lake center.

Lake Vegetation Index

The LVI score for this lake was 33 out of a possible 100 points, corresponding with a Category III "Impaired" designation. Table 2 contains the species list and occurrence information for this sampling event. A total of 10- 11 invasive exotic plants were observed in the lake. *Hygrophila,* observed in section 12, could not be confirmed as the native or invasive exotic species because of the lack of fruiting structures at the time of observation. One invasive exotic, *Hydrilla verticillata*, dominated two sections, but showed signs of stress by a confirmed herbicide treatment by Lake County Water Authority. No dominant plant was observed in section 6.

Table 2. Species list for the August 23, 2011 LVI at Lake Eustis. An asterisk (*) indicates an invasive exotic plant species. P = present, D = dominant, C = codominant.

Species	Sections:	3	12	6	9
Acer rubrum	RED MAPLE	P	P	P	P
Alternanthera philoxeroides*	ALLIGATOR WEED	P	P		
Amaranthus	PIG WEED	P		P	
Baccharis	SALT MYRTLE		P	P	
Cephalanthus occidentalis	COMMON BUTTONBUSH	P	P	P	P
Ceratophyllum demersum	COONTAIL		P		
Ceratopteris thalictroides	WATERSPRITE	P			
Chara	MUSK GRASS		P		P
Cinnamomum camphora*	CAMPHOR TREE	P	P		
Cladium jamaicense	SAWGRASS		P		P
Colocasia esculenta*	TARO; WILD TARO	P	P	P	
Crinum americanum	SEVEN-SISTERS; STRING-LILY		P		
Cyperus alternifolius*	UMBRELLA SEDGE	P	P	P	
Cyperus strigosus	STRAWCOLORED FLATSEDGE	P		P	
Echinochloa	BARNYARD GRASS			P	
Eclipta alba	YERBA DE TAJO	P			
Fraxinus caroliniana	CAROLINA ASH; POP ASH		P	P	P
Fuirena	RUSH FUIENA		P	P	
Hydrilla verticillata*	HYDRILLA	D	P		D
Hydrocotyle	MARSHPENNYWORT	P	P		
Hygrophila*?	HYGROPHILA		P		
Ilex cassine	DAHOON				P
Kosteletzkya	KOSTELETZKYA		P		
Ludwigia leptocarpa	ANGLESTEM PRIMROSEWILLOW	P	P	P	
Ludwigia peruviana*	PERUVIAN PRIMROSEWILLOW	P	P		
Lycopus rubellus	TAPERLEAF WATERHOREHOUND		P		
Mikania scandens	CLIMBING HEMPVINE	P	P	P	
Myrica cerifera	WAX MYRTLE		P		P
Najas guadalupensis	SOUTHERN WATERNYMPH		D		P
Nuphar	COW LILY	P	P	P	P
Nymphaea odorata	AMERICAN WHITE WATERLILY				P
Panicum hemitomon	MAIDENCANE	P	P	P	P
Panicum repens*	TORPEDO GRASS	P	P	P	P
Paspalidium geminatum	PASPALIDIUM; KISSIMMEEGRASS	P	P	P	P
Paspalum repens	WATER PASPALUM	P	P	P	P
Phragmites australis	COMMON REED			P	
Pistia stratiotes	WATER-LETTUCE	P			
Pontederia cordata	PICKERELWEED	P	P	P	P
Potamogeton illinoensis	ILLINOIS PONDWEED	P		P	
Sabal palmetto	CABBAGE PALM	P	P		P
Sagittaria lancifolia	BULLTONGUE ARROWHEAD	P	P	P	P
Sagittaria latifolia	DUCK POTATO	P			
Salix caroliniana	CAROLINA WILLOW	P	P	P	P
Salvinia minima*	WATER SPANGLES	P	P		
Sambucus canadensis	ELDERBERRY	P	P	P	
Schinus terebinthifolius*	BRAZILIAN PEPPER		P	P	P
Schoenoplectus californicus	GIANT BULLRUSH	P		P	
Schoenoplectus pungens	SWORD GRASS			P	P
Sesbania	SEED BOX	P	P		
Taxodium	CYPRESS		P	P	P
Typha	CATTAIL	P	P	P	P
Utricularia gibba	HUMPED BLADDERWORT	P	P		
Utricularia inflata	SWOLLEN BLADDERWORT	P	P		P
Vallisneria americana	TAPEGRASS; AMERICAN EELGRASS	P	P	P	P
Vigna luteola	HAIRYPOD COWPEA	P			
Xanthosoma sagittifolium*	ELEPHANT EAR	P	P	P	P
Zizania aquatica	ANNUAL WILD RICE; INDIAN RICE			P	

Summary

Nutrient levels in Lake Eustis have been associated with imbalances in the lake's floral community. Chlorophyll *a* measured in Lake Eustis (15 µg/L) during the June 8, 2011 sampling event by SJRWMD indicates that the lake is not exceeding proposed water quality standards, however, compliance is based on an annual geometric mean. The TN concentration is greater than the new minimum water quality criterion, but is within the range of allowable TN concentrations if the annual geometric mean of chlorophyll *a* is below 20 µg/L. Decreased light penetration from elevated chlorophyll levels has the potential to impacted Lake Eustis's submersed plant community. *Najas guadalupensis,* a beneficial native submersed plant dominant in section 12, will have an increasingly difficult time competing against *Hydrilla verticillata*, dominant in sections 3 and 9, with elevated nutrient levels and decreased light penetration.

Lake Eustis will benefit when the TMDL targets are achieved to reduce nutrient loads from its watershed. Additionally, a management plan to promote native submersed and littoral vegetation and upland buffers, and control submersed and emergent exotic vegetation would help improve the LVI score.

Thank you for your interest in maintaining the water quality of Florida's lakes. Please feel free to contact us if you have any questions.

Contact and resources for more information

David Scharr david.scharr@dep.state.fl.us

Lake Eustis TMDL document:

http://www.dep.state.fl.us/water/tmdl/docs/tmdls/final/gp1/eustis_haines-creek-tp-tmdl.pdf

Technical Publication SJ2004-5, Pollutant Load Reduction Goals for Seven Major Lakes In The Upper Ocklawaha River Basin

http://www.sjrwmd.com/technicalreports/pdfs/TP/SJ2004-5.pdf

DEP publications on Best Management Practices and Environmental Stewardship and Education: http://www.dep.state.fl.us/water/nonpoint/pubs.htm DEP biological assessment resources: http://www.dep.state.fl.us/water/bioassess/index.htm

FWCC Aquatic Plant Management: http://myfwc.com/wildlifehabitats/habitat/invasive-plants/aquatic-plant/

Freshwater Algal Bloom information: http://www.dep.state.fl.us/labs/biology/hab/index.htm