



Lake Holden Water Chemistry 03-19-08 - Rick Richbourg

A very brief and selective history

- Once upon a time all was sweetness and light
- Lake Holden was clear and native plants were able to clean lake naturally
- BY 1973 Lake becomes choked with plants
- 1974 White Amur (grass carp) released in lake to eat plants
- BY 1979 White Amur eat ALL macrophyte vegetation
- 1980 macrophyte "biomass" is gradually replaced by algae biomass
- In the 1980's Aeration project on lake
- By mid 1980s Aeration project fails to provide desired results
- 1990 TSI has degraded to Hypereutrophic state with TSI > 69 TP= 52
- About 1993 FDOT retention pond installed
- 1996 Alum Treatment goes online.
- About 1998 Old Shire Property acquired for retention
- March 2005 just prior to first surface alum treatment TP= 35
- March 2006 Last of 3 surface alum treatment concludes - 04/06 TP = 17
- 2008 TSI has improved to Mesotrophic TSI = 54 TP= 17

Trophic State Index (TSI)

Carson's TSI was first adapted for Florida lakes by Dr. Brezonik in 1984. The index he developed expresses the productivity of the lakes specifically in Florida. The TSI that Dr. Brezonik developed has four classes:

- Oligotrophic 0-49
- Mesotrophic 50-60
- Eutrophic 61-69
- Hypereutrophic >69

Why we use TSI

The quantities of nitrogen, phosphorus, and other biologically nutrients are the primary determinants of a lake's trophic state index. Nutrients such as nitrogen and phosphorus tend to be limiting resources in standing water bodies, so increased concentrations tend to result in increased plant (algae too) growth, followed by corollary increases in subsequent trophic levels. Consequently, a lakes trophic index may often be used to make an estimate of its biological condition.

Lake TSI explained

Oligotrophic lakes are generally associated with good water quality. They have low levels of phosphorus, nitrogen, and algae and have very little sedimentation. They also have narrow littoral zones (shoreline vegetation) and a sparse fish population.

As lakes age over hundreds of years, these factors increase. The lakes become more productive and thereby classified as **Mesotrophic lakes**.

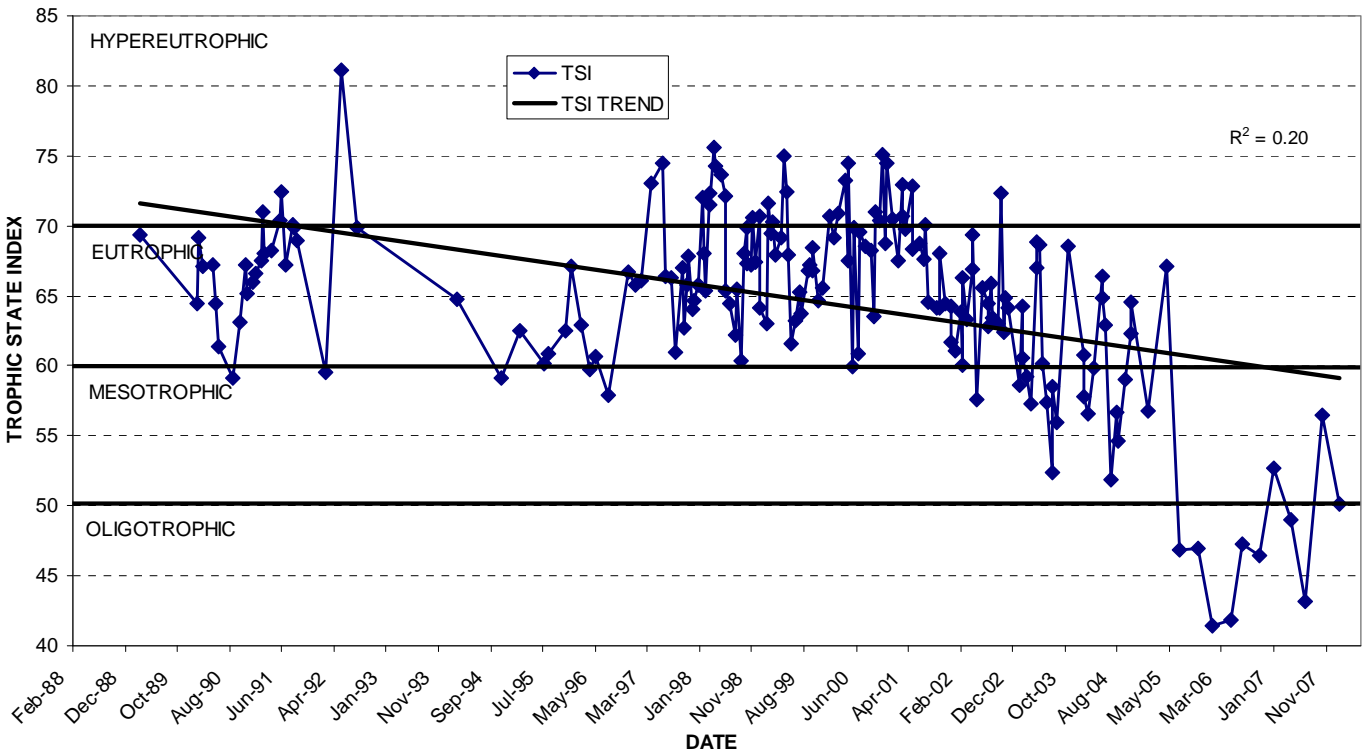
Eventually, the lakes become rich in phosphorus and nitrogen, sedimentation increases, and algal blooms begin to occur. Terrestrial plants begin to flourish along the littoral zone in turn widening this zone. The population of fishes, aquatic organisms, birds, and other wildlife increases. The lake eventually is classified as **Eutrophic**.

When these activities become extreme, the lake becomes **Hypereutrophic**. Typically hypereutrophic lakes have a consistency of pea soup.

Florida lakes naturally shift from oligotrophic to eutrophic conditions as they age. This process is called eutrophication. Urban areas can dramatically accelerate the eutrophication process.

One of the tasks of our Water Advisory Board is to mitigate the accelerated eutrophication process.

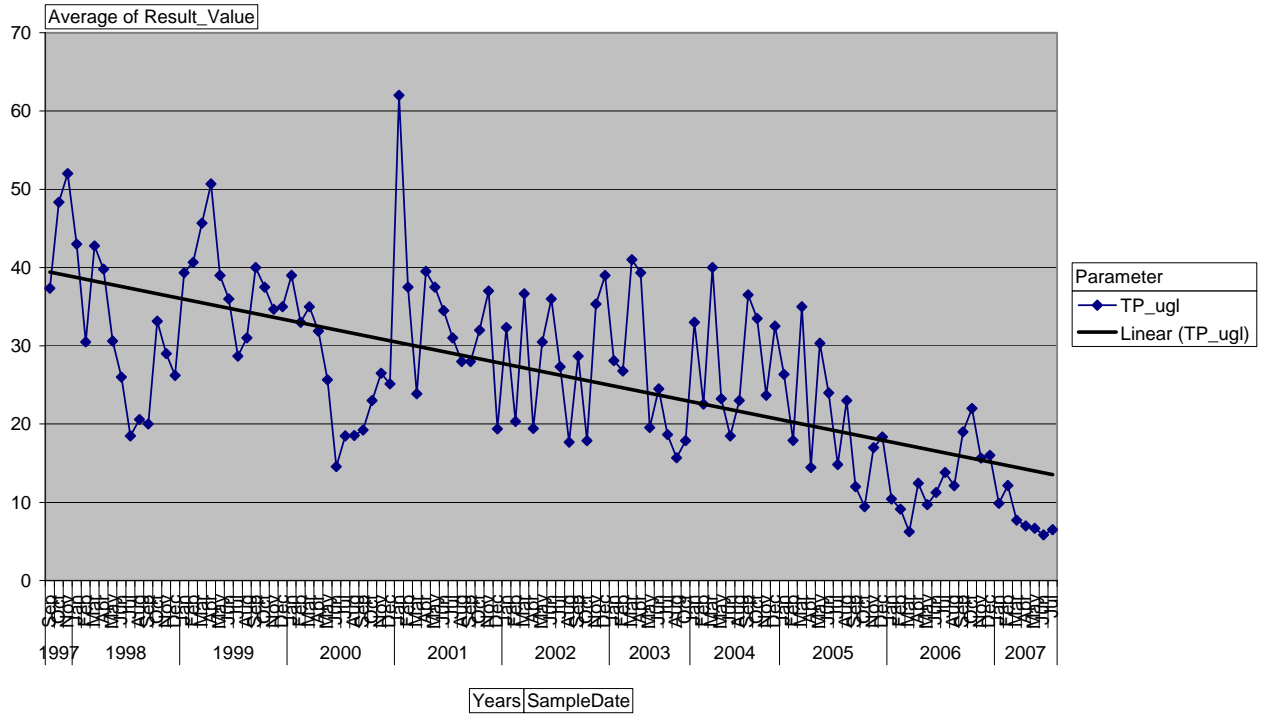
Lake Holden TSI Trend from March 1989 to January 2008 - City of Orlando



WaterBodyName|HOLDEN, LAKE|StationID|(All)

Lake Holden 10 Year TP Trend

$$y = -0.231x + 39.642$$
$$R^2 = 0.4383$$



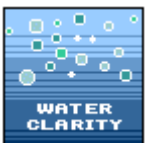


Latest Value	Limiting Nutrient	Historic Range
54 (Good)	PHOSPHORUS	13 (Good) - 75 (Poor)
9/6/2007		2/11/1990 - 9/6/2007
Source: Orange County Surface Water Quality		
274 samples		

GOOD 0-59 Fully supports designated use.
FAIR 60-69 Partially supports designated use.
POOR 70-100 Does not support designated use.



Parameter	Latest Value	Historic Range
Total Nitrogen (TN)	650 ug/l 11/4/2007	270 - 2400 ug/L 2/11/1990 - 11/4/2007
	Source: LAKEWATCH Volunteer Water Quality Monitoring	284 samples
Total Phosphorus (TP)	18 ug/L 11/4/2007	2 - 62 ug/L 2/11/1990 - 11/4/2007
	Source: LAKEWATCH Volunteer Water Quality Monitoring	282 samples
Chlorophyll	11.6 ug/L 10/3/2007	0.5 - 85 ug/L 2/11/1990 - 10/3/2007
	Source: Orange County Surface Water Quality	245 samples



Parameter	Latest Value	Historic Range (All Locations)
Secchi Depth	3 ft 10/3/2007	0.7 - 12.5 ft 2/11/1990 - 10/3/2007
	Source: Orange County Surface Water Quality	269 samples
Turbidity	2.8 NTU 10/4/2007	0.3 NTU - 13.7 NTU 1/21/1998 - 10/4/2007
	Source: Orange County Surface Water Quality	101 samples

Phosphorus Limited

Phosphorus limits the growth of good plankton and increases the production of algae by providing a food source for the algae. Lake Holden is a phosphorus limited lake and controlling the amount of phosphorus will help reduce the algae in the lake by decreasing its food source. The net result of reduce phosphorus – we hope

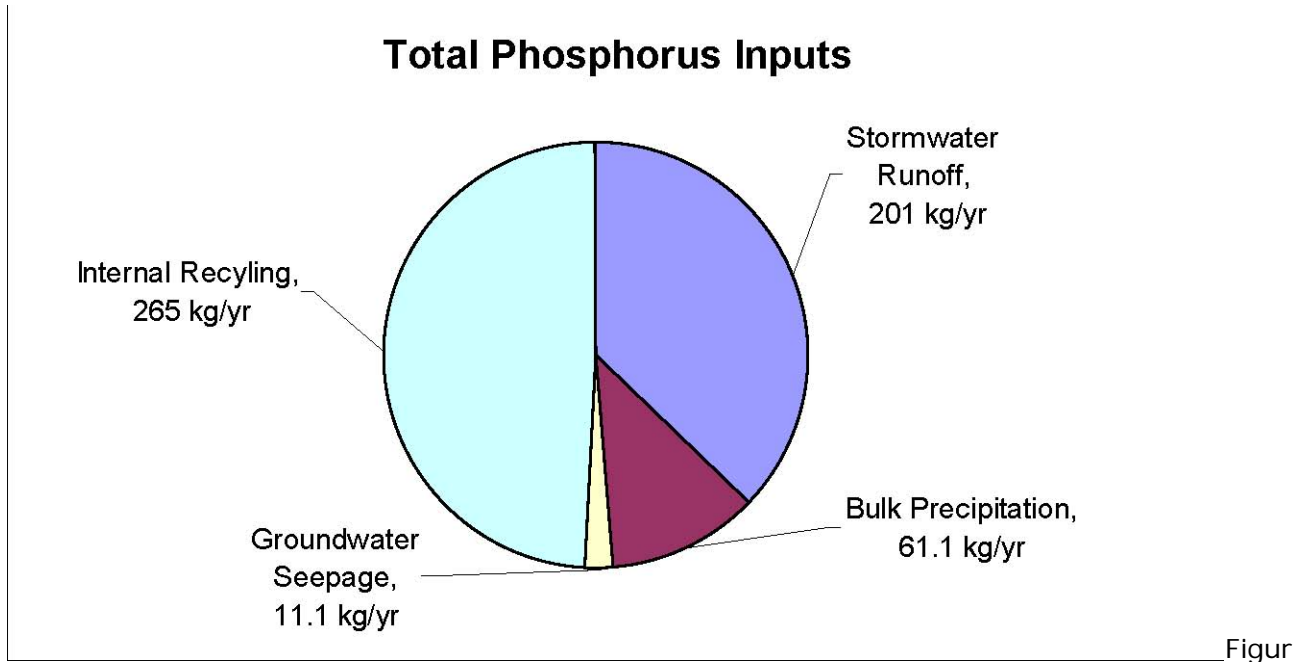


Figure 4-10. Comparison of Inputs of Total Phosphorus in Lake Holden. Lake Holden Revised Hydrologic / Nutrient Budget and Management Plan May 2004

The chart above shows approximately that nearly half the phosphorus in the lake is due to internal recycling. Natural and man made causes of Internal Recycling is beyond the scope of this document.

Currently there are only 4 recognized lake management “tools” for dealing with phosphorus:

1. Aeration
2. Dredging
3. Bacteria
4. Alum

Of the available options for controlling phosphorus in Florida Lakes, option 4 is the least controversial, most cost effective management tool available to us.

The Take Away

The Trophic State Index is one of the primary metrics used to gage the biological health of any lake. The Lake Holden TSI has been improving consistently since the 1990s. Lake Holden was once the second “dirtiest” lake in Orange County in a Hypereutrophic condition. It is now ranked in the mid way on the list of Orange County lakes with an improving TSI in the Mesotrophic range. The amount of phosphorus in the water column has remained stable since the last Alum Treatment in 2006 at 17 micrograms per liter. While we have much more to do, Lake Holden is indeed improving. Certainly something not all Orange County Lakes can claim.