NONPOINT SOURCE SUCCESS STORY

Florida

Modular Wetland Project Improves Bay Lake Water Quality

Waterbody Improved

Water quality impacts from nutrient loading and polluted runoff from nonpoint sources led the Florida Department of Environmental Protection (DEP) to add Bay Lake to Florida's Verified List and the Clean Water Act (CWA) section 303(d) list of impaired waters for nutrients. Subsequently, DEP developed a nutrient total maximum daily load (TMDL) that was adopted by rule in 2008. In response, project partners implemented nutrient reduction practices including wetland enhancement upstream of Bay Lake. Reductions in chlorophyll *a*, total nitrogen and total phosphorous loadings into Bay Lake demonstrated that the project has had a positive impact on water quality.

Problem

Bay Lake (WBID 3004G) is in the Group 2 Middle St. Johns watershed in north-central Orange County within the city of Orlando, Florida (Figure 1). It is a Class III lake waterbody designated for recreation and the propagation and maintenance of healthy, well-balanced fish and wildlife populations. The predominant land uses in the Bay Lake watershed are 82% urban; 6% wetlands; and 6% transportation, communication and utilities. Bay Lake has an area of roughly 36 acres, and the surrounding watershed encompasses an area of roughly 211 acres.

In 2004, DEP placed Bay Lake on the state's Verified List and the CWA section 303(d) list of impaired waters for nutrients. There are no point sources within the Bay Lake watershed, and nonpoint sources include septic systems and surface water runoff. The Bay Lake watershed is mostly urbanized, which has led to portions of the watershed being highly modified and engineered. Hydrologic modifications altered the natural flow of water discharging to the lake, which caused the nutrient concentrations to increase and eventually exceed the state's applicable water quality standard for Class III waterbodies. In 2008 DEP wrote a nutrient TMDL for Bay Lake that calls for a 39% reduction in the total nitrogen (TN) load and a 66% reduction in the total phosphorus (TP) load entering the lake.

Story Highlights

In 2012, the Bay Lake wetland treatment system project was selected for Florida's CWA section 319(h) funding. This project was a partnership with Orange County Environmental Protection Division. The project

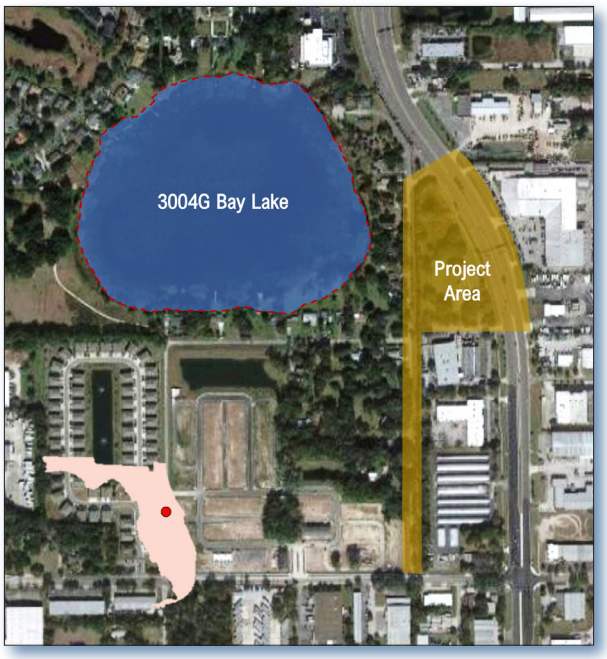

Figure 1. Bay Lake is in the Middle St. Johns River watershed in Orange County, Florida.

was designed and constructed to address nonpoint source pollution impacting Bay Lake and to provide flood control and water quality improvement benefits. The section 319 funding was used to install two modular wetlands to treat road runoff upstream of Bay Lake. Each modular wetland contained biosorption activated media (BAM) that supported the growth of wetland vegetation (vetiver grass) and aided in pollutant removal. The various components of this project were constructed to absorb nutrients, enhance water quality, and reduce pollutant loadings to Bay Lake.

Bay Lake Nutrient Data (Annual Geometric Means)				
Year	Chlorophyll-a (µg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	
2008	28	2.03	0.02	
2009	35	2.2	0.03	
2010	39	2.57	0.03	
2011	28	ID*	0.04	
2012	33	2.51	0.03	Lake Restoration project agreement was initiated in 2012.
2013	19	2.15	0.03	
2014	20	1.87	0.03	
2015	14	1.33	0.02	Lake Restoration project agreement was completed in 2015.
2016	7	1.21	0.02	
2017	5	0.71	0.01	
2018	2	0.64	0.01	
2019	3	0.61	0.01	
*Indicates there was insufficient data to calculate an annual geometric mean in 2011				

Figure 2. Bay Lake nutrient data (annual geometric means) show improvement.

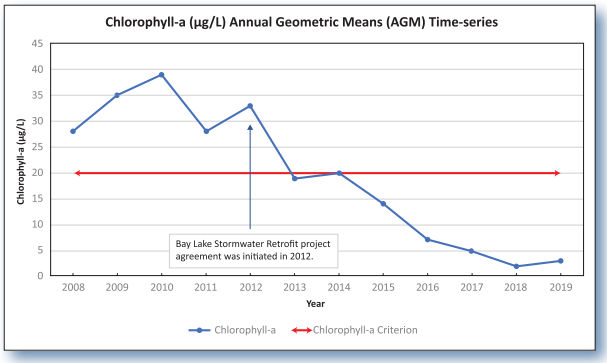

Figure 3. Chlorophyll *a* levels dropped after project implementation.

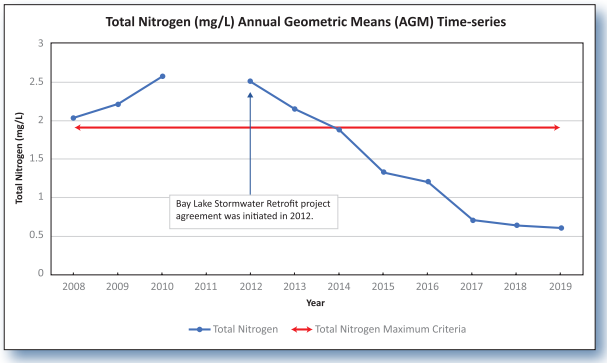

Figure 4. Annual geometric mean total nitrogen concentrations in Bay Lake.

Figure 5. Aerial images show the difference in Bay Lake before (left) and after (right) project implementation.

Results

Thanks to the efforts of the involved stakeholders, nutrient concentrations within Bay Lake have remained below the state's impairment criterion since 2015. The completion of the Bay Lake modular wetland project resulted in load reductions of roughly 8 pounds (lbs)/year total nitrogen, 1 lbs/year total phosphorus and 371 lbs/year total suspended solids. Figure 2 shows the nutrient annual geometric means for the time periods before, during and after the lake restoration project agreement was implemented in 2012. The period of record consists of 12 years of data collected at two monitoring stations by the City of Orlando.

The chlorophyll *a* annual geometric means in the during/post-project time period (2013–2019) show concentrations decreased from a maximum value of 39 micrograms per liter (µg/L) in 2010 (pre-project) to a maximum value of 20 µg/L in 2014 (during restoration project agreement). Post-project annual geometric means have consistently remained below the state's impairment criterion of 20 µg/L (Figure 3). Similar improvements are also observed in TN and TP annual geometric mean concentrations (Figure 4). Maximum pre-project values of 2.57 milligrams per liter (mg/L) for TN in 2010 and 0.04 mg/L for TP in 2011 decreased, with the most recent post-project values of 0.61 mg/L for TN and 0.01 mg/L for TP in 2019. The reductions in the chlorophyll *a*, TN and TP concentrations demonstrate the project has had a positive impact on water quality within Bay Lake (Figure 5).

Partners and Funding

The Orange County Environmental Protection Division was awarded Fiscal Year 2012 CWA section 319(h) funding for the Bay Lake Project in the amount of $150,000. Orange County provided $180,943 in match funding.

U.S. Environmental Protection Agency
Office of Water
Washington, DC

EPA 841-F-21-001EE
December 2021

For additional information contact:

Amanda Peck
Florida Department of Environmental Protection
850-245-2952 • Amanda.Peck@floridadep.gov