Case Study

Three Lakes Watershed Water Quality Modeling

Client

Three Lakes Association

GLEC Services

Grant Preparation

Water Quality Modeling

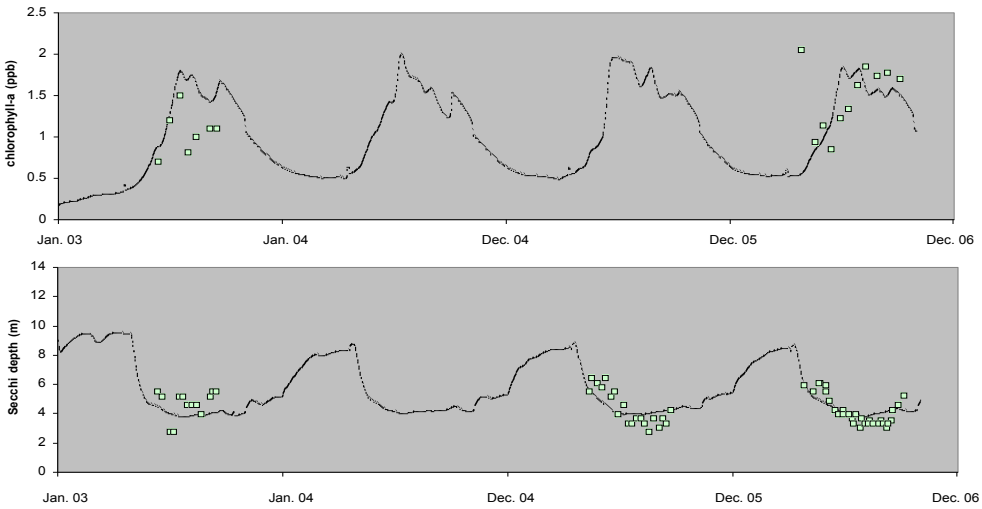
Water Quality Sampling Design

Low Level Nutrient Analyses

Sediment Trap Deployments

GLEC and Three Lakes Association (TLA) cooperated in the development of predictive nutrient-based water quality models for the Three Lakes System (Torch Lake, Lake Bellaire and Clam Lake) located in northern lower Michigan's Antrim County. The projects were funded by two competitively-awarded water quality monitoring grant from the Michigan Department of Environmental Quality (MDEQ). The primary project goals included: (1) the collection of data necessary to develop a mathematical model of water quality in the Three Lakes System; (2) model calibration and confirmation; and, (3) application of the model to address present water quality concerns and forecast future changes in water quality due to increased nutrient loadings associated with changing land uses and development.

Clam Lake Macrophtyes - 2006 Aerial



Graphs comparing model predictions to data for chlorophyl-a and Secchi depth in Lake Bellaire

Phosphorus-based predictive water quality models were developed for each of the Three Lakes using the Lake2K-Lite framework. This PC-based model simulates the seasonal and long-term dynamics for a number of significant water quality in a seasonally-stratified lake. Settling rates for all particulate nutrients were specified according to fluxes measured in sediment traps. The model predictions of temperature, dissolved oxygen, total phosphorus, chlorophyll and Secchi depth were judged to be acceptable in comparison to data for 2003-2006. A watershed modeling approach was developed and applied to predict current and future watershed phosphorus loads to each of the lakes for a number of scenarios intended to represent realistic population growth and development in the Three Lakes watershed. Changes in phosphorus loadings to each of the Three Lakes were calculated with the watershed model for anticipated developments in Alden and Shanty Creek. The changes in phosphorus loading predicted by the watershed model for each of the scenarios were used in conjunction with the water quality models to simulate the expected water quality response to the loading changes. These results illustrate that the models are capable of forecasting water quality changes to evaluate the impacts of development and land use changes. Results from these projects provided TLA and its decision-making partners with useful objective tools for evaluating how changes in nutrient loadings, resulting from land use development, are expected to affect short- and long-term changes in water quality in the Three Lakes. As a practical example, TLA has used the models to evaluate the expected water quality impacts of a dredging project being planned at the mouth of a major tributary in the drainage basin.

www.glec.com
231-941-2230

Contact: Doug Endicott, Environmental Engineer
dendicott@glec.com