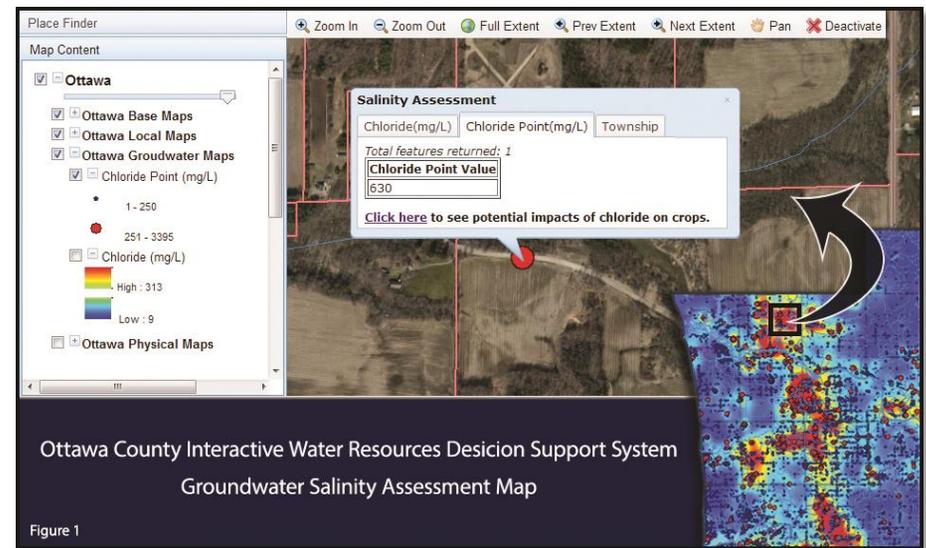


## ELUCID – Ottawa County

ELUCID- Environmental Learning Using Computer Interactive Decisions- is an upcoming and customizable system developed by the Michigan State University Institute of Water Research. ELUCID illustrates the complex interactions in coupled human and natural systems through a GIS environment. One of ELUCID's greatest assets is its ability to engage and inform different user groups and address multiple issues in one system. This is accomplished through its unique design. Each customized ELUCID system is organized into varying themes such as water quality, basement flooding or land protection. Users investigate these themes through a mapping interface which automatically loads relevant theme data. Furthermore, ELUCID can be linked to existing systems to enhance its analytical capabilities.

ELUCID was pioneered as part of the Comprehensive Water Resource Study for the Ottawa County Planning Commission. Since 2005, Ottawa County has experienced instances where aquifers have not had the capacity to support existing or new development, and increased demand for groundwater has generated discussions regarding whether withdrawals are exacerbating brine, nitrate, and other contaminant levels in wells.

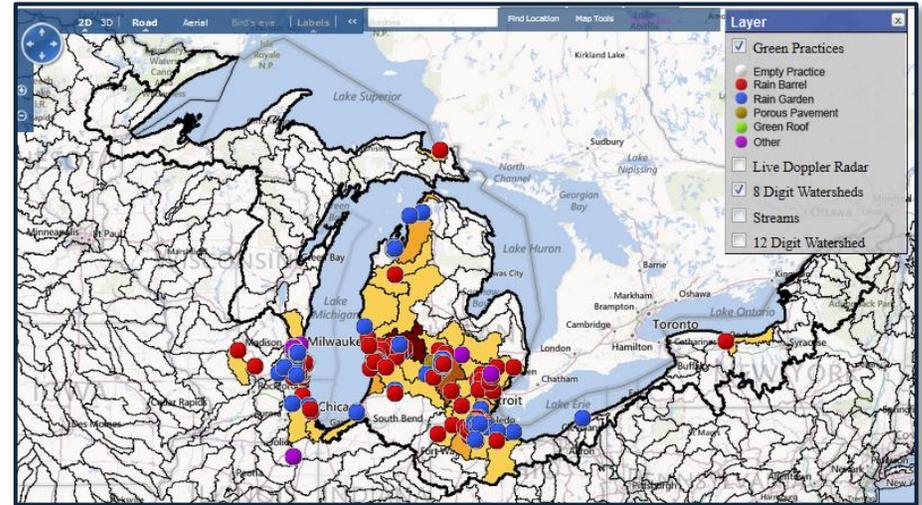
The ELUCID system, known as the Interactive Water Resources Decision Support System (IWDSS), used in this study helps address these urgent water concerns. The IWDSS uses a web-based environment with GIS capabilities and provides interactive plan-view maps and cross-sectional views of portions of the county to: (a) determine the aerial extent and large-scale variation in aquifer characteristics, (b) provide a depiction of the general groundwater flow regime (direction and rate), (c) map the concentrations of sodium, chloride, nitrate, and arsenic from water well samples, and (d) determine the fluctuations of water table depth. This IWDSS system adopts the so-called “mobile first strategy” so the system can be run on any device including tablets, smart phones and PCs. The flexible interface also offers tight integration with tutorial information for users and allows them to click on the map to query for specific assessments of water quality and quantity conditions to guide local decision-making.



Preliminary findings from the data analysis indicate some disturbing trends in groundwater quality and quantity in the Ottawa County area. Increasing withdrawals from both the glacial and bedrock aquifer systems have resulted in a lowering of the static water levels. This situation is being worsened by the fact that no master recharge area can be found in the entire county due to the existence of the extensive clay layer in its geological structure. The groundwater in the bedrock aquifer is becoming more saline (i.e., increasing chloride concentrations) through time, likely due to saline water from deeper in the bedrock aquifer migrating upward toward the top of the saline Marshall formation as water withdrawals continue to increase. Finally, nitrate concentrations are elevated (greater than 3 mg/L) in many areas of the county. There are numerous hotspots throughout the county where the nitrate concentrations are 5 - 10 times the drinking water standard. These analyses, provided through the IWDSS and developed by the IWR in association with many partners, have proven useful in rapidly addressing water resource concerns within the county.

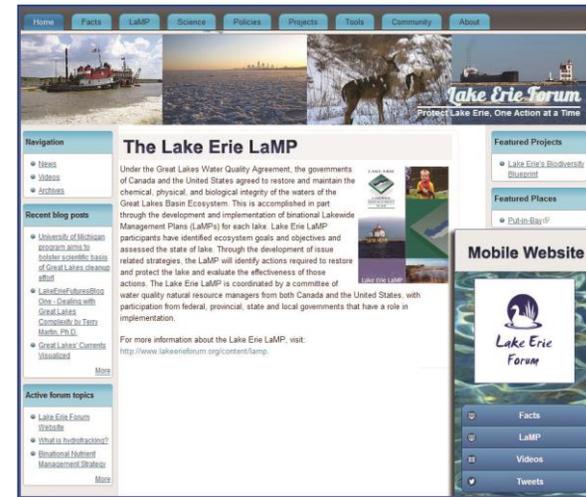
**Networked Neighborhoods, [www.networkedneighbors.org](http://www.networkedneighbors.org)**

Networked Neighborhoods for Eco-Conservation Online (NECO) is a web-based tool created by IWR and funded by the Great Lakes Protection Fund. The website helps individuals in the Great Lakes region map and share green practices (rain barrels, rain gardens, and other low impact practices) they have put in place or are interested in implementing. NECO uses both social networking and mapping technology to link people together with the common goals of improving the Great Lakes Basin, their watershed, town or their own back yard. The website summarizes the total water managed by these practices and reports pollutant reductions using Purdue University's Long Term Hydrologic Impact Analysis model (L-THIA) for nitrogen, phosphorus, sediment, and fecal coliform. During 2012, 68 new users registered an account with NECO and 220 new practices were recorded. Overall, 233 users have registered on the site and 1088 practices have been recorded. The Michigan Department of Environmental Quality plans to add 319 projects to the website. IWR expects to improve NECO's interface and make it accessible on mobile devices during 2014.



**Lake Erie Forum, <http://www.lakeerieforum.org/>**

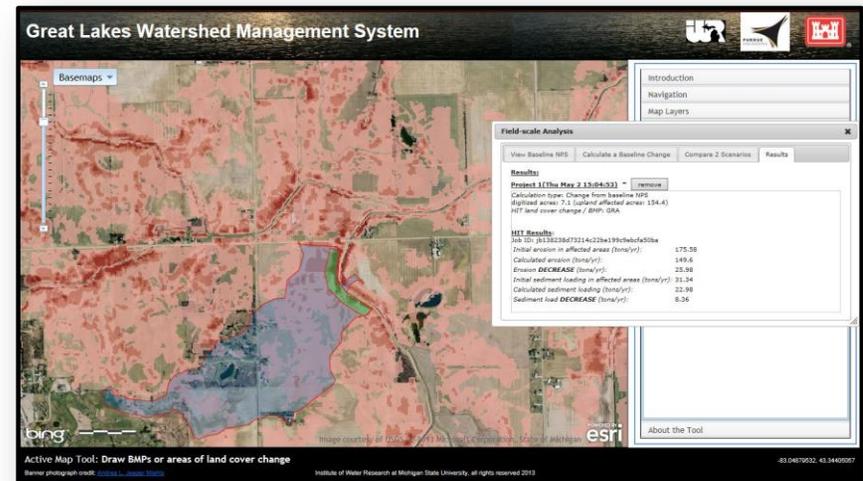
In collaboration with the Ohio Environmental Council, the Institute of Water Research at Michigan State University (IWR) developed a web portal for the Lake Erie Lakewide Action and Management Plan (LaMP) Public Forum. This portal, funded by EPA through a GLRI grant, is a one-stop shop for all Lake Erie related information, with sources from both the United States and Canada. It features useful facts on Lake Erie, current research activities, policies and laws involving Lake Erie, a video gallery, and decision support tools such as web-based mapping applications. The mobile version of the site (<http://lakeerieforum.org/m/>) also allows farmers, teachers and citizens to utilize the information whether they are out in the farm field or canoeing on a river. Additionally, people concerned with Lake Erie's nutrient status can access the recently released Lake Erie Binational Nutrient Management Strategy at the portal.



## Great Lakes Watershed Management System,

<http://35.8.121.111/glwms/map.aspx>

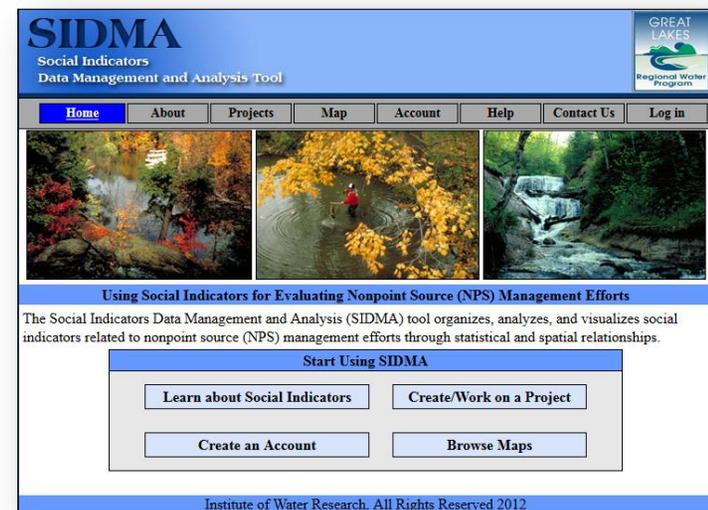
As part of a continuing partnership with U.S. Army Corps of Engineers and Purdue University to reduce sediment and nutrient loading to Great Lakes waters, IWR is developing a Great Lakes Watershed Management System (GLWMS). The system will allow users to map sediment and nutrient loadings at various watershed scales, and conduct field-scale BMP scenario modeling. The joint effort is an expansion of previous Corps funded projects to provide similar analysis tools to the Burns-Ditch/Trail Creek and Swan Creek watersheds. However, whereas those previous efforts were applied to relatively small watersheds, the GLWMS will be initially available for four larger basins: The Fox River of Wisconsin, the Maumee River of Ohio, the Saginaw River of Michigan, and the Genessee of New York. These basins were selected as pilots because of their identification as priority area under GLRI. The GLWMS links IWR's High Impact Targeting (HIT) model and Purdue's Long Term Hydrologic Impact Assessment model (L-THIA) in a single on-line mapping interface. User testing is currently underway. A formal release is expected in the coming months, followed by proposals to expand the GLWMS beyond its initial pilot watersheds.



## Social Indicators Data Management and Analysis,

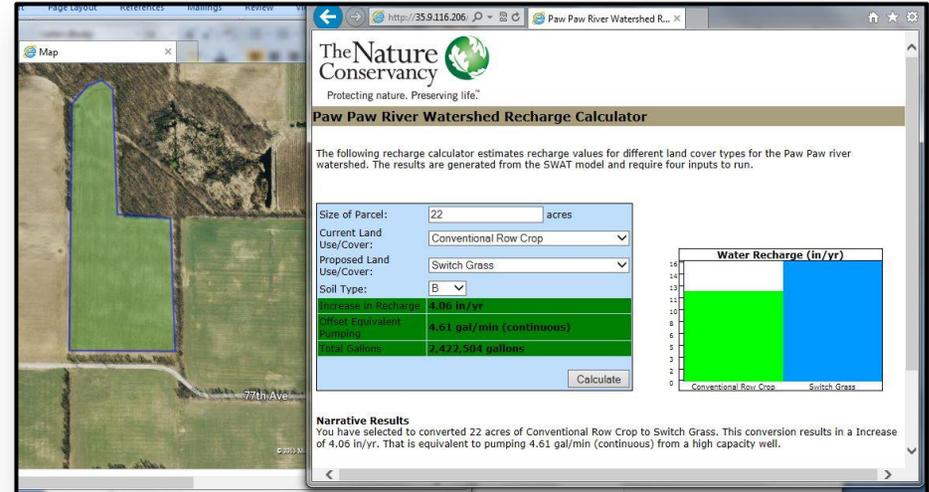
[www.iwr.msu.edu/sidma](http://www.iwr.msu.edu/sidma)

Water quality problems have accumulated over many decades and may take decades to amend. Confirming that awareness and attitudes are changing and behaviors are being adopted in a watershed is one way that projects can demonstrate progress toward water quality goals. Social indicators provide consistent measures of social change within a watershed and can be used by managers at local, state, and federal levels to estimate the impacts of their efforts and resources. As part of the Social Indicators Planning and Evaluation System (SIPES) project, the Michigan State University Institute of Water Research developed a web-based project management aid that support SIPES watershed projects. The Social Indicator Data Management and Analysis (SIDMA) system organizes, analyzes, and visualizes social indicators, related to nonpoint source (NPS) management efforts through statistical and spatial relationships. To date, the system has 105 SIDMA projects on the website.



### Sediment and Groundwater Recharge Calculator

In 2010, IWR worked with The Nature Conservancy and Coca-Cola to develop an on-line groundwater recharge calculator. In an effort to offset the withdrawals of a new bottling plant in Michigan’s Paw Paw River Watershed, Coca-Cola was interested in supporting land conservation practices that facilitate groundwater recharge. With collaboration from the Agricultural Engineering Department at Michigan State University, IWR built an on-line mapping interface where users could draw an area of BMP or land cover change, and then estimate a potential change in groundwater recharge. Recharge estimates are based on SWAT model outputs of various land cover and soil type combinations. TNC partnered with the Van Buren County Conservation District to identify priority locations and promote practices that optimize groundwater recharge. The tool was expanded in 2012 to include the ability to estimate sediment loading reductions based on estimates from the HIT model. With new support from the Mott Foundation, TNC and IWR are expanding the groundwater recharge and sediment calculators to Michigan’s entire Saginaw Bay basin. An initial version of the system is expected to be completed by the end of 2013.



### Water Withdrawal Assessment Tool, [www.miwwat.org](http://www.miwwat.org)

The Water Withdrawal Assessment Tool (WWAT), designed for individuals preparing a new or increased water withdrawal, was jointly developed by the Groundwater Conservation Advisory Council, US Geological Survey, Department of Natural Resources, the Department of Environmental Quality, and Michigan State University to meet as part of Michigan’s water withdrawal legislation. The web-based interface, developed by the IWR, helps users with potential water withdrawals to determine whether their proposed withdrawal will have an adverse resource impact on nearby streams. The IWR has maintained the system since its inception and is in the process of improving the WWAT’s interface. Approximately 1900 wells have been registered between July 2009 and February 2013. Another component of Michigan’s water withdrawal legislation requires high capacity water users to annually report their water use. The IWR developed an online reporting system for the Michigan Department of Agriculture and Rural Development. The system went into effect in 2012.

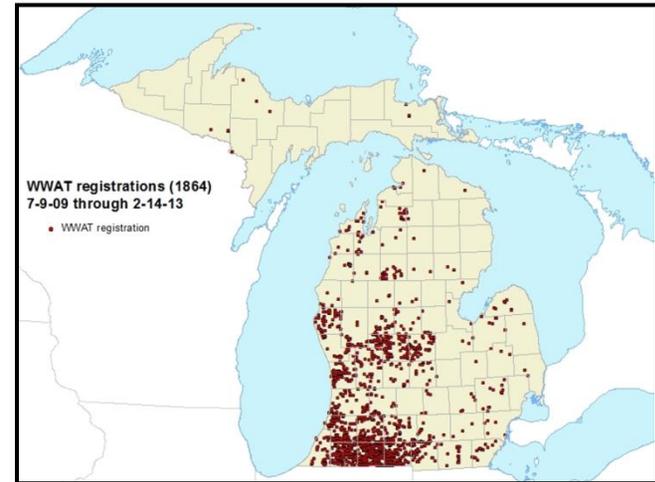


Photo Credit: Jim Milne, Michigan Department of Environmental Quality