Nearshore Health and Watershed Protection Projects for the Great Lakes Restoration Initiative

The Great Lakes Restoration Initiative (GLRI) is an interagency program that addresses the most significant environmental problems in the Great Lakes ecosystem. Results from U.S. Geological Survey (USGS) scientific studies and monitoring are helping guide the restoration effort. The GLRI is made up of five focus areas that address these issues:

- Cleaning up toxic substances and areas of concern
- Combating invasive species
- Promoting nearshore health by protecting watersheds from polluted runoff
- Restoring and protecting habitats and wildlife
- Tracking progress and working strategically with partners

USGS project results are presented here for the promoting nearshore health and protecting watersheds from polluted runoff focus area. More information is available on the USGS GLRI Web page (*http://cida.usgs.gov/glri/*).

Great Lakes Beach Recreational Water-Quality Decisionmaking

Research by USGS scientists has been instrumental in providing beach managers with the tools to make beach closure and advisory decisions at some of the 500 beaches along 11,000 miles of coastline in the Great Lakes. As they broaden the understanding of microbiological science, USGS scientists are able to develop and refine predictive models (or "nowcasts") that estimate the concentration of bacteria more rapidly than other methods, allowing beach managers to make effective beach closure and advisory decisions.

The USGS is also compiling data on recreational water quality in comprehensive databases and geographic information systems (GIS); enabling the technology transfer of rapid analytical methods to beach managers; and applying new field and laboratory methods for pathogens, indicators, and Microbial Source Tracking (MST) markers. This information is critical for protecting public health at Great Lakes beaches and for restoring Great Lakes coastal ecosystems.

Results include the following:

Real-Time Assessments

- Easily measured variables, such as rainfall and turbidity, are being used in models to estimate water-quality conditions, allowing the beach manager to better evaluate the need for an advisory or closing.
  - Modeling activities have been expanded to more than 50 Great Lakes beaches. The USGS is working closely with local agencies to provide them with the tools and expertise to develop models for beaches.
  - Nowcast systems, similar to the Ohio nowcast, (*http://www.ohionowcast.info*) are planned for implementation in 2013 at many Great Lakes beaches.

  - New variables that explain physical and biological processes affecting fecal indicator bacteria (FIB) concentrations are being investigated.
  - Alternative statistical techniques to improve the accuracy of model predictions are being tested.
- Rapid analytical methods have provided analytical results within 2 to 3 hours. Training and technology transfer was provided to beach managers to apply and evaluate rapid analytical methods.

Pathogens and Microbial Source Tracking

- The occurrence of MST markers and pathogens of concern are being determined at beaches susceptible to various sources of fecal pollution.
  - Sampling strategies and analytical methods for bacterial, protozoan, and viral pathogens and MST markers are being developed and applied.
    - In 2010, more than 150 samples were collected at Great Lakes beaches and analyzed for MST markers. Human-specific markers were detected in 29 percent of the samples, and bovine-specific markers were detected in 13 percent.
    - More than 400 samples collected in 2010 at Great Lakes beaches are being analyzed for pathogenic bacteria.
  - The relationships between FIB concentrations and pathogen or MST marker detections or concentrations are being determined.
  - Environmental conditions associated with pathogen occurrence are being identified.
  - USGS scientists are working with partners to identify remediation options.

Coastal Processes

- The transfer of bacterial indicators, pathogens, and MST markers to the nearshore waters, sediments, groundwater, and lake water is being characterized to provide important information to beach managers for protecting public health.
  - The role of surface and buried beach debris and algae on FIB concentrations in beach sand and submerged sediments is being evaluated.
    - A numerical model that determines wave distribution at arbitrary locations in the beach area was developed and holds to the key to sediment resuspension.
    - Model simulations of current flow nearshore at Chicago 63rd Street Beach were conducted. This model could provide detailed current flow velocity under various offshore (deepwater) conditions.

Beach-Data Analysis, Interpretation, and Communication

- Recreational-water-quality information on Great Lakes beaches is being made available in a user-friendly formation to enhance communication with beach managers and the public.
  - A publicly accessible, Web-based, interactive GIS system is being developed that allows visualization of Great Lakes-wide water-quality and environmental data associated with beaches.
  - A comprehensive database is being developed to assemble environmental data collected at Great Lakes beaches and integrate real-time data (such as rainfall) from additional sources.

Great Lakes Nutrient and Sediment Loading Nowcasts and Forecasts

USGS scientists are collecting real-time and near-real-time streamflow and water-quality data from tributaries flowing into the Great Lakes. This project builds upon the existing monitoring efforts that are used in watershed computer models. These models are used to determine the status of nutrient loading to each Great Lake and forecast potential future changes in loading.

Results include the following:

- Thirty monitoring sites were equipped with automated samplers and real-time water-quality monitoring sondes (sensors). Samples are analyzed for nutrients, chloride and other major ions, and suspended sediment, and the sondes measure dissolved oxygen, turbidity, specific conductance, pH, and temperature.
- At each site, monthly samples are collected, and as many as six large-rainfall event samples are collected.
- At some sites, detailed mapping of the rivermouth-lake interface was completed using an Automated Underwater Vehicle (AUV) and a boat outfitted with an array of water-quality monitoring sondes. This information is used to further understand the river-lake interactions.

Phosphorous Load Estimations for Great Lakes Basin Watershed in Wisconsin

USGS scientists are documenting water quality and determining the amount and sources of phosphorus in each of the Winnebago Pool Lakes in eastern Wisconsin. The Winnebago Pool is a series of interconnected lakes draining into the largest lake, Lake Winnebago. Water from Lake Winnebago flows north through the Lower Fox River and into Green Bay and Lake Michigan. Information from the project is being used to develop total maximum daily loads (TMDLs) for the Winnebago Pool Lakes and provide TMDL information for the Lower Fox River and Green Bay. TMDLs are calculations of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. Samples and information collected are used in water-quality models to simulate the amount of phosphorous (load) in each of the Winnebago Pool Lakes and provide water managers with a tool for making decisions.

Results include the following:

- Sediment cores were collected and analyzed for phosphorus release rates in all lakes and tributaries.
- Streamflow and water quality were measured in all major tributaries to Lake Winnebago.
- Buoys were installed on Lake Winnebago and used to monitor dissolved oxygen conditions in the lake.
- SPARROW (SPAtially Referenced Regression On Watershed) models were used to describe phosphorus loading throughout the watershed.

Data Collection for Estimation of Total Maximum Daily Loads in a Great Lakes Basin Watershed in Indiana

USGS scientists collected fish community information to help develop total maximum daily loads (TMDLs) and to prepare implementation plans for water-quality impaired Areas of Concern and tributaries in the Great Lakes Basin. TMDLs are calculations of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. The Pigeon Creek/Pigeon River watershed in northeastern Indiana is an example of a tributary to the Great Lakes that was listed in 2008 as impaired for biotic communities under the Clean Water Act by the Indiana Department of Environmental Management (IDEM). Sediment and nutrient concentrations were initially suspected as potential causes of the impairment. Sampling to determine the fish community structure in the Pigeon Creek watershed was identified as a critical need to assist U.S. Environmental Protection Agency (USEPA) and IDEM clarify the main causes of impairment in the Pigeon Creek watershed.

Results include the following:

- The USGS conducted electrofishing surveys at 37 stream sites in the Pigeon Creek/Pigeon River watershed.
- Information collected at each site included water temperature, pH, specific conductance, and dissolved oxygen and fish identification, weight, length, abundance, and anomalies indicating impaired health. IDEM collected related water-quality samples and additional properties.
- Stream-water samples were analyzed for nutrients, sediment, and other constituents. Physical characteristics such as streamflow were measured, and degraded habitat was noted to classify pollutant sources and characteristics that contribute to the biological impairment of the watershed and to identify TMDLs to address sources, improve water quality, and remove the impairment.
- Fish community statistics were compiled and an index of biotic integrity (IBI) score was computed for each site in the Pigeon Creek/Pigeon River watershed.
  - Twelve of 15 wadeable sites had an IBI habitat status of Good to Excellent.
  - Of 22 headwater sites, only one had an IBI habitat status of Good, 2 were Fair, 11 were Poor, and 8 were Very Poor.
- All data are being analyzed by IDEM to identify potential causes of the biotic impairment in the Pigeon Creek/Pigeon River watershed. Preliminary observations indicate that seasonal low flows in the headwater streams may be a factor affecting the observed biotic impairment.

Stream Geomorphology Training

Five USGS scientists provided a one-week training course titled, "Geomorphic Analysis of Fluvial Systems" to U.S. Environmental Protection Agency and state and local agencies in Chicago. The course provided an introduction into the concepts of stream (fluvial) geomorphology (study of landform history and dynamics used to predict future change) and examples of geomorphic analysis, assessment, and monitoring. The knowledge gained from this training is helping state and local managers to better understand how water and sediments move through an area and aid them in identifying sources of pollutants that are not originating from a single location.

Great Lakes RESTORATION

Contact:
Norman G. Grannemann
6520 Mercantile Way
Lansing, MI 48911
nggranne@usgs.gov
517-887-8937