Frequently Asked Questions about the Lake Erie Nutrient Case Study

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Questions about the study scope

What is the purpose of this study?

The purpose of this study was to identify the monitoring design and water data needed to answer the case-study policy question, "How effective are agricultural management practices at reducing nutrients from nonpoint sources at the watershed scale?" in the Lake Erie drainage basin, evaluate the availability and usability of existing data to answer the case-study policy question, and identify approaches for filling data gaps to answer the case-study policy question.

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Why assess the availability of water data?

As policy issues evolve, new priorities and challenges arise for natural resource assessment, and new approaches to monitoring are needed. There is a need to evaluate whether today's water monitoring programs are generating the information needed to answer questions surrounding new policy priorities. Recent harmful algal blooms and dead zones in Lake Erie have raised the visibility of agriculture in the Lake Erie drainage basin, and its role in nutrient transport to the lake. This report evaluates whether the water data needed to understand the effectiveness of agricultural management practices at the watershed scale are being collected so they can be used to inform new policies for improving water quality in Lake Erie.

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How was the case-study policy question selected?

Nutrient enrichment was selected by the project team as the case-study subject due to the importance of the issue to policy makers and the Northeast Midwest region. The Northeast-Midwest Institute interviewed Congressional and Senate staff and decision-makers participating in the Blue Ribbon Project Steering Committee to identify their most urgent water-quality questions related to nutrient enrichment to help design a relevant case study. Twelve Congressional offices and 18 Steering Committee members, including representatives from the federal government, states, cities, industry, and environmental groups, participated in these discussions and their responses were distilled into priority policy questions.

With respect to nutrient enrichment, questions around the effectiveness of conservation and management practices for reducing nutrient loadings from nonpoint sources were raised most frequently. Decision-makers wanted more information about the effectiveness of management practices to better characterize environmental impacts of nutrient runoff, identify strategies for reducing algal blooms and related ecosystem impacts, and assist design of cost-effective incentives to balance agricultural and environmental interests.

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How was the geographic scope of this study selected?

The Technical Advisory Committee and Steering Committee selected the Lake Erie drainage basin because it:

- Encompasses multiple states and the receiving water body is located within the region, making it a good test for a regional multi-agency study.
- Nutrients in the basin come from a mix of agricultural and urban sources, making the basin representative of nutrient issues being faced across the NEMW region.
- There are several agencies and universities that have long histories of monitoring water quality in the basin, making for a rich data set for evaluation.
- A recent focus on Lake Erie due to harmful algal blooms allows this study to build on other studies evaluating the science of Lake Erie.

The Lake Erie drainage basin encompasses parts of Canada, but Canadian water-quality data were not available for analysis through this study.

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What are agricultural management practices?

The term "management practice" is used in this report to encompass methods that have been referred to as (1) conservation practices, methods that reduce soil erosion and retain soil moisture (U.S. Department of Agriculture, 2014a); (2) Best Management Practices (BMPs), a practice or system of practices designed to prevent or mitigate damage or adverse effects caused by farming, construction, manufacturing, or other anthropogenic activities (U.S. Department of Agriculture, 2014a); and (3) other methods for reducing nutrient loadings from nonpoint sources to receiving waters. The term "agricultural management practices" is used to designate management practices designed for use on agricultural lands.

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What is the difference between the report and the addendum?

The report presents findings based on monitoring sites that were active as of December 2014. The addendum describes new, expanded, and planned monitoring sites as of February 2015 and updates the report findings based on the new monitoring plans.

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Questions related to compiling multi-agency water data and its usability for this study

Who are the major water monitoring organizations in the Lake Erie drainage basin?

- The Heidelberg Tributary Loading Program operated by the National Center for Water Quality Research at Heidelberg University.
- The U.S. Department of Agriculture (USDA) Agricultural Research Service (ARS) Upper Cedar Creek Conservation Effects Assessment Project (CEAP).
- The Great Lakes Restoration Initiative (GLRI) Priority Watershed edge-of-field studies conducted by the U.S. Geological Survey (USGS).
- The USGS operates the majority of streamgages located at water-quality monitoring sites described in the report.
- The National Oceanic and Atmospheric Administration (NOAA) National Estuarine Research Reserve System (NERRS).
- The Ohio Environmental Protection Agency (OH EPA).
- The Great Lakes Restoration Initiative (GLRI) tributary monitoring program.
- The Ohio Department of Natural Resources-USGS Ohio Water Science Center cooperative program.
- Other USDA research studies.

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What types of water data were compiled and assessed through this study?

The data compiled for this study focused on monitoring data for streams and rivers in the Lake Erie drainage basin, and included selected water-quality parameters and streamflow-monitoring information. These water-quality data were collected by at least 17 different organizations in the Lake Erie drainage basin, and came mostly from a national-scale multi-agency compilation of water-quality data assembled by the U.S. Geological Survey (USGS), called the "National Data Aggregation" (Argue et al. 2014). The National Data Aggregation consists of water-quality and associated hydrologic data collected by federal, state, and regional governmental agencies and non-governmental organizations. The largest online data sources were the U.S. Environmental Protection Agency (USEPA) Storage and Retrieval (STORET) Data Warehouse (U.S. Environmental Protection Agency, 2014) and the USGS National Water Information System (U.S. Geological Survey, 2002 and U.S. Geological Survey, 2014b).

A subset of the National Data Aggregation covering the United States area of the Lake Erie drainage basin ("nutrient data set" in this report) served as the primary data set for assessing existing water-quality monitoring data in this case study. The nutrient data set also includes subsequent updates and

additions made specifically for this project, resulting in part from suggestions by the study's Technical Advisory Committee members familiar with local monitoring programs. Data records in the nutrient data set span the period 1943 through 2013, with date ranges varying by organization, site, and parameter; record end dates range from 2009 to 2013 among the primary organizations actively collecting data. Water monitoring data for total phosphorus and dissolved reactive phosphorus in streams were emphasized in this report's water quality data assessments.

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What types of data were not compiled for this study?

The following types of data were not compiled for this study:

- Agricultural management practice implementation and maintenance data,
- Water data from Canadian tributaries,
- Open lake water-quality data,
- Temperature and precipitation data, and
- Data on lake health endpoints, such as drinking water toxicity, hypoxia, and fish productivity.

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What items were important to include in the water data compilation used in this study?

To develop the data compilation required for this study, it was important to convert data in various formats from multiple agencies into a standardized format to be able to query the data set. Assembling this standardized data compilation required reviewing "metadata" (consisting of data-code definitions, quantification qualifiers, and other information describing the sample or laboratory analysis) to determine the chemicals (or combined chemicals) measured, fraction of sample analyzed (e.g. filtered or whole water), and reporting units. This was a time-intensive task that required technical expertise to accurately identify and apply uniform naming conventions for measured water quality parameters. There also was a need to match water quality monitoring sites with streamgages and to acquire drainage area data. If this information was not available, GIS methods were used to identify the nearest streamgage and to determine the drainage area upstream of each monitoring site.

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What issues or challenges did you encounter when compiling water data for this study?

Some agencies report their water data to a centralized multi-agency online source while others do not, which makes the data more difficult to find and obtain. To obtain water quality data not residing in existing multi-agency sources was a time-intensive process involving online searches, knowledge of

monitoring organizations and(or) assistance from local water researchers to provide this information, locating monitoring staff contacts and communicating via email or phone to identify relevant data sets and request the data. Some challenges in compiling these data included time lags between the data request and data sharing, variations between agencies in the parameter naming conventions and in the completeness of metadata provided. Metadata important for the data compilation sometimes resided in a database separate from the monitoring data (which had to be located and (or) searched through) or for some data sets the metadata were incomplete. The lack of important metadata limited the usefulness of some data sets for interpretive evaluation. The end date of the monitoring records varied among organizations; some organizations maintain their data archives on a regular schedule, whereas other organizations' records for public release had not been updated for several years. These issues can reflect limitations in the number of staff available in the monitoring organization to prepare, document, and quality-assure their internal records for public data sharing.

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Questions related to water data availability in the Lake Erie drainage basin

What data are needed to answer the case-study policy question?

There are three parts to the study design that must be in place to be able to generate answers to this policy question. First, appropriate monitoring sites are needed. Monitoring sites must be located in watersheds dominated by agricultural land use, and where management practices can and will be widely implemented for reducing nutrient loss. Second, tributary water-quality and streamflow data must be collected at these monitoring sites with sufficient sampling frequency and longevity to evaluate trends in concentration and load over time. Third, ancillary data on management practice implementation and other changes in land use and nutrient sources throughout the watershed must be available to correlate water-quality change with alterations on the land. Details can be found in Chapter 5 of the report.

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Are the needed water data available?

The study found that existing water-quality monitoring is inadequate for measuring the effectiveness of agriculture management practices in the Lake Erie drainage basin. As of February 2015, only 15 of the 1,890 current or historical water quality monitoring sites in the Lake Erie drainage basin are located in priority areas and use the minimum sampling frequency for detecting reductions in nutrient loads at the watershed scale.

Four of these monitoring sites meet the large watershed monitoring criteria described in section 5.5 of the report. The needed large watershed data are being collected at monitoring sites on the Raisin, Maumee, and Sandusky Rivers where they discharge into the western basin of Lake Erie.

The 11 small watershed monitoring sites that meet the small watershed monitoring criteria are as follows:

- Two small watershed monitoring sites, Rock Creek in Ohio and Nickelsen Creek in Indiana (planned) have the complete study design for answering the case-study policy question: monitoring design, conservation practice incentive program, and a data sharing agreement (see Addendum Table 4).
- Two small watershed monitoring sites, Eagle Creek in Ohio and Black Creek in Indiana (planned) are located in watersheds that are not priority areas for water quality monitoring. However, these sites do use the minimum sampling frequency, and have the needed conservation practice incentive program and data sharing agreement (see Addendum Table 4).
- The monitoring site at Unnamed Tributary to Lost Creek, OH has the needed monitoring design, but does not have a conservation practice incentive program within the monitored watershed.
- Recent increases in sampling frequency at Old Woman Creek, OH (1 site) and U.S. Department of Agriculture (USDA) Agricultural Research Service (ARS) monitoring sites (5 sites) in the Upper Cedar Creek Conservation Effects Assessment Project (CEAP), in Indiana meet the monitoring criteria. The 5 USDA monitoring sites do not offer geographical representation of the Lake Erie drainage basin.

A minimum of six small watershed monitoring sites with the complete study design are needed. Although 11 monitoring sites meet the case study monitoring criteria, only 2 of these sites have the complete needed study design.

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Why is it difficult to obtain ancillary data on agricultural management practice implementation?

There are significant logistical, institutional, and legal barriers to assembling and sharing management practice data, including the confidentiality restrictions outlined in Section 1619 of the Farm Bill and other access limitations (Weller et al., 2010). As a consequence, water-quality researchers must depend on farmers' willingness to share their land management data. Agricultural management practice implementation data, when they are available, are further complicated by a lack of documentation at the level of detail needed for water-quality analysis (Jackson-Smith et al., 2010).

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What are major nutrient sources in the Lake Erie drainage basin?

Four categories of nutrient sources contribute to watershed nutrient loadings in the Lake Erie drainage basin, both point and nonpoint sources:

1. Point-source contributions, which include industrial sources, wastewater-treatment plants, and combined sewer overflows;

2. Non-agricultural sources, which include septic systems, urban, and residential nonpoint sources;
3. Landscape based sources, which include forest and atmospheric nonpoint sources; and,
4. Agricultural nonpoint sources.

Tributaries draining into the western Lake Erie drainage basin contribute the greatest external nutrient loadings to the lake, and the Maumee River is the largest single source of DRP to Lake Erie (International Joint Commission, 2014). The western basin of the lake received approximately 64 percent of average-annual phosphorus loadings to Lake Erie during 2003-2011 (International Joint Commission, 2014), compared to 26 percent to the central basin and 11 percent to the eastern basin. Nonpoint sources accounted for 61 percent of the total phosphorus load to the entire lake, but 71 percent of the load to the western basin (Report Figure 5; Ohio Lake Erie Phosphorus Task Force, 2010). Estimates indicate between 33 and 44 percent of the Lake Erie nonpoint-source total phosphorus load comes from agricultural sources (Robertson and Saad, 2011).

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How do excessive nutrients affect water quality in Lake Erie?

Record harmful algal blooms driven by nutrient loadings to Lake Erie have affected water quality, fish populations, tourism and the economy across the entire Lake Erie region for the past several years. A bloom in August 2014 resulted in a drinking-water advisory for the city of Toledo, Ohio, restricting water use for 400,000 people for three days. Hypoxia, deadzones, and related impacts on ecosystems and fisheries are also consequences of excessive nutrients in the lake. Section 2.3.2 of the report provides further information on the water quality impacts of excessive nutrients in Lake Erie.

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What is the difference between Total Phosphorus (TP) and Dissolved Reactive Phosphorus (DRP)?

Two primary measurements of phosphorus are used to measure the overall phosphorus contributions to Lake Erie and its tributaries from nonpoint land-based sources, point sources, and atmospheric sources. Total phosphorus (TP) refers to all forms of phosphorus and includes both particulate and dissolved forms. Although TP is not completely bioavailable to stimulate algal growth, much of it could become available in the future as a result of biological and chemical processes. The dissolved, reactive portion of TP that directly stimulates algal growth is often referred to as bioavailable phosphorus, dissolved reactive phosphorus (DRP) or soluble reactive phosphorus (SRP) (International Joint Commission, 2014). In addition to these more common terms, DRP is also equivalent, or nearly equivalent, to dissolved orthophosphate, soluble reactive phosphorus (SRP), dissolved inorganic phosphorus (DIP), filterable reactive phosphorus (FRP), total dissolved phosphorus (TDP) and reactive phosphorus for a filtered sample. TP and DRP were selected for detailed analysis in this case study.

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Questions related to next steps

What are the study recommendations for filling the data gaps?

- Locate new small watershed monitoring sites and conservation incentive areas in unmonitored high priority watersheds.
- Identify modifications to existing water monitoring and conservation incentive programs that allow for the most efficient use of small watershed monitoring resources. A coordinating entity should lead this collaborative planning process enlisting both water monitoring and agriculture organizations.
- For both existing and new water quality monitoring sites, maintain sampling for a minimum of ten years after new agricultural management practices are installed to evaluate their effectiveness in reducing nutrient loading.
- Substantially increase the use of agricultural management practices to generate statistically significant nutrient load reductions at both small and large watershed scales in the Lake Erie drainage basin.
- Ensure access to management practice implementation and land use data in monitored watersheds to quantify the relationship between these practices and water quality trends.
- Adopt common data-management standards, data-entry protocols, and consistent naming and coding conventions across monitoring agencies.
- Additional monitoring agencies should submit data annually to the U.S. Environmental Protection Agency (USEPA) Storage and Retrieval (STORET) Data Warehouse and additional partners should participate in the Water Quality Portal.

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What are the next steps in this project?

The Northeast-Midwest Institute and the U.S. Geological Survey undertook two case studies to illustrate the types and amounts of data needed to answer urgent water policy questions and to determine how much of those water-quality data are currently available. This report summarizes one case study: our investigation of water-quality data relating to nutrient enrichment in the Lake Erie drainage basin. A companion case-study investigating the availability of water-quality data for assessing the impacts of shale gas development on water resources in the Susquehanna River Basin will be presented separately. The results of these case studies will inform a qualitative review of water data availability across the Northeast-Midwest region in an upcoming State of the Region Report.

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How will the Northeast-Midwest Institute use this information?

The Northeast-Midwest Institute will share study results with national and regional decision makers through a policy education program that includes briefings and congressional office visits to describe the

availability of water-quality data for answering urgent water policy questions, implications for effective decision making, and strategies for improving our water knowledge base for addressing future water issues.

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Where can I learn more about the Northeast-Midwest Institute?

Information about the Northeast-Midwest Institute can be found on their website.

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Where I can I learn more about U.S. Geological Survey (USGS) National Water Quality Assessment (NAWQA) Program?

Information about the NAWQA Program can be found on their homepage.

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