Understanding Sources and Transformations of Nutrients in Agricultural Landscapes from Headwaters to the Great Lakes

The lower Great Lakes are experiencing a resurgence of eutrophication, which includes the occurrence of nuisance and harmful algal blooms in the lakes. The causes of the current issues are not fully established, but it is likely that changes to the timing and types of nutrients delivered to the Lakes are important. Reducing inputs of nutrients to Lakes Huron, Erie, and Ontario from a variety of sources is one of the few ways we can reduce algal growth. Therefore, it is important to understand the mechanisms by which nutrients are lost from the landscape, the timing and magnitude of these losses, and how in-river processes affect their delivery to, and their potential effects, on the Great Lakes. All sectors must do their part to reduce nutrient losses, including waste water treatment, urban development, and agriculture.

Multi-Watershed Nutrient Study (MWNS)

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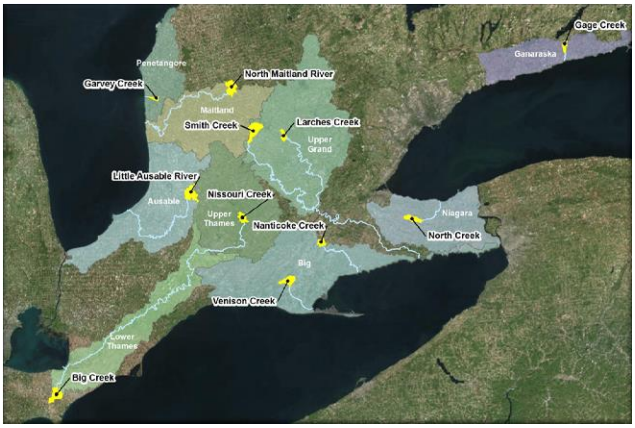
The MWNS is an Ontario Ministry of the Environment and Climate Change (MOECC) led research study. We are examining how agricultural land management and features of the landscape relate to nutrient losses in agriculturally dominated areas of the Great Lakes basin. Eleven headwater sentinel watersheds in the basins of Lakes Huron, Erie, and Ontario, have been selected for detailed study. These watersheds are representative of the range of agricultural areas in Southern Ontario. Study of the MWNS watersheds includes monitoring of stream discharge, water quality, and weather. Associated effort exists to survey the land management in these watersheds.



Agricultural Land Management Survey

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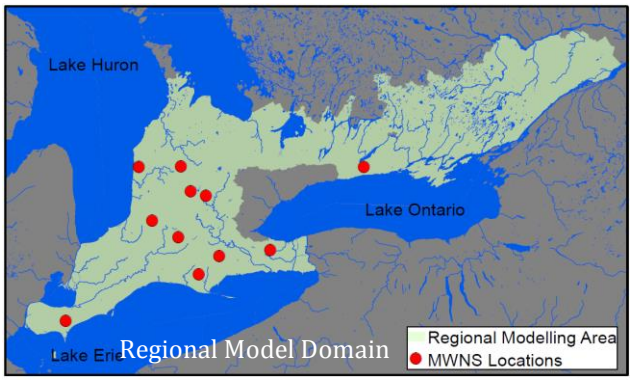
A number of studies are currently trying to link efforts to improve agricultural production with improvements to water quality. In the absence of direct input from agricultural producers, scientists and policy makers must make assumptions about land management when conducting regional scale assessments. To fill this gap in our knowledge, Ryerson University and the University of Windsor have begun a study on agricultural land management in the MWNS sentinel watersheds. In 2017 and 2018, agricultural producers will be invited to participate to ensure their land stewardship is accurately portrayed. Those who choose to participate will be asked detailed questions about their crop rotations, tillage practices, fertilizer use, manure management, drainage, and soil or water conservation measures. Current practices will be compared to historical observations from the 1970s. Comparing land use information with water quality from a range of sites will reveal how differences in agriculture and the physical environment relate to water quality. Understanding the implications of land management for Great Lakes water quality requires a regional scale mathematical model.

Ryerson University

University of Windsor

Regional Watershed Modelling



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Several watershed-modelling projects are currently being developed across Southern Ontario. Existing watershed modelling projects typically develop predictions at the mouths of larger rivers. However, a focus on the main outlet can overlook the significant differences in land management and physiography throughout Southern Ontario. Sentinel headwaters, such as those in the MWNS, provide an opportunity to incorporate detailed information into a regional model. In 2016, Ryerson University and the University of Windsor began a 3-year project incorporating headwater sentinel watershed information to evaluate the relationship between agricultural land management, physiography, and watershed nutrient loading from agricultural watersheds throughout Southern Ontario. The deep historical data record at the sentinel watersheds provides an opportunity to understand in greater spatial detail how land management and water quality have evolved since the 1970's. In order to understand how well the regional model captures the dynamics of a large river, a detailed study on the Thames River has begun.

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Thames River Project

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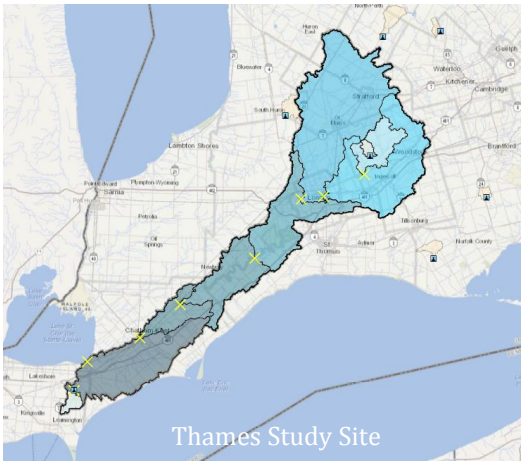

The Thames River and its valley has become a region of intense research, monitoring, and nutrient reduction programs as the Thames is the single largest input of phosphorus to the Western Basin of Lake Erie from Canada. A significant knowledge gap that remains is how improvements in the headwaters would likely be translated to results at the river mouth. This is because nutrients undergo physical, chemical, and biological processes between source areas and Lake St. Clair. This knowledge gap will affect our ability to inform on how actions in the watershed result in benefits to the lake. In 2017, the University of Waterloo began a 3-year project to improve our understanding of nutrient forms, transformations, and removal mechanisms within the Thames River valley and how these processes may influence the eutrophication-potential of nutrients delivered to the lake. The study will also examine the role of areas such floodplains and reservoirs in retaining nutrients that would otherwise be delivered to the lake as well as potential opportunities to enhance these retention processes. A synthesis report, consolidating existing knowledge and data pertaining to P sources, transformation, export, and bioavailability within the Thames River watershed will be produced. It is anticipated that the understanding generated at the Thames River will be of value in guiding the management of other large rivers in Southern Ontario.

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Stakeholder Engagement

A key aspect of these projects is the need to engage stakeholders from the beginning to ensure the results are useful. Please contact any of the project leads to learn more about the projects and how you can be involved!