ESTIMATION OF ATRAZINE ENTERING LAKE ERIE THROUGH RUNOFF FROM AGRICULTURAL LANDS IN THE LAKE ERIE BASIN

FINAL REPORT

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ABSTRACT

There have been growing concerns over the potential risks of contamination of drinking water. While pesticides have been widely used to control unwanted plants and destructive insects, a large amount of pesticide residues discharged into our environment, including the Great Lakes, which serve as a primary water supply source for various ecosystem functions including human activities, economic development, and numerous faunal and floral populations. The runoff losses of pesticide during storm events can result in extensive deterioration of surface water quality.

As the result of a joint project among the Air Quality Research Branch of MSC, the University of Regina, and the Environmental Conservation Branch of EC, a Pesticide Runoff Model (PeRM), has been developed to predict the runoff losses of pesticides from agricultural lands in the Lake Eries Basin. This model is an integration of a mathematical model, relational database, and Geographic Information System (GIS). The information of soil type, land use, land slope, watershed boundary, precipitation, pesticide usage, the physical and chemical properties of pesticides and others have been digitized and gridded by using GIS, and put in a database, and ready for use by the mathematical model. By using these data, the mathematical model can calculate the pesticide losses due to runoff by considering the emissions, chemical and biological degradation of pesticides, adsorption and desorption of pesticide to and from soil particles, and the movement of pesticides in the dissolved and adsorbed phases. All results from the mathematical model are put in the database, and runoff pattern along with pesticides loss will be simulated by using a powerful database management system. The final results will be displayed and

visualized using GIS. Furthermore, the model has been coded to form a software package with user-friendly interface. The Microsoft® Visual C® and Visual Basic® were used to do the programming. The objective of this package is trying to let any researchers with limted training could use it for simulating the pesticide transport by surface runoff.

As the base of the simulating the pesticide loss through surface runoff from the agricultural land, a 10 km × 10 km grid system was created to cover the study area. After searching from various sources, an integrated database was also developed and further combined with the grid system. The database is composed of various datasets, such as watershed, soil, climate, hydrology, landuse, water quality sample, and topography datasets. A set of sensitivity tests was also carried out. These were designed by examining the model ouput which ranges over two orders of magnitude and assessing which variables are largely responsible for this variation. Some parameters or variables have been found with strong impacts on the model, such as half-life, organic matter, curve nubmer and appolication conditions. Through a case study in the Auglaize-Blanchard Watershed, northern Ohio, the model was calibricated and verified by the observed data.

The determination of of atrazine loss conditions in the Lake Erie Basin is the main objective of this study and has been achieved throught the model simulation. According to the hydrological properties, the Lake Erie Basin was divided into 36 Hydrologic Units and each unit was defined as an index. The pesticide runoff model (PeRM) was used to estimate the atrazine loss from each unit and to the Lake Erie-Lake St. Clair system. For each river located in the basin, its contribution of atrazine loss to the water system was clarified. The daily atrazine flux and concentration through water discharge were

provided, which presents a clear concept of atrazine loss in the Lake Erie Basin. Generally, USA side has bigger contribution of atrazine loss to the Lake Erie comparing with the Canadian side. From the view of entire Lake Erie Basin, the atrazine pollution is serious in western and southern sub-basins and atrazine concentration in the river mouth usually exceed the related standards in the wettest season. The information came out from this study is believed to have high value for both of the pesticide management and water quality control.

This report is to assemble the results from our work into a document that reflects not only advanced scientific understanding, but also the practicalities of producing usable numbers at the end of the study. It is clear that further work is desired to improve the usability of the model and related pesticide pollution study in the Great Lakes Basin.