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Natural Champions

The *Nutrient Management Pilot Project Final Summary Report* and *CANWET User's Guide* describe a leading edge computer modeling initiative developed as part of a pilot project in three Ontario subwatersheds. The modeling tool will assist resource managers in predicting changes in water quality associated with human activities and altered landscapes, as well as evaluating the implementation of agricultural and urban pollution reduction strategies.

Nutrient Management Pilot Project Summary Report



In December 2001, the Ministry of the Environment, Ministry of Natural Resources and Conservation Ontario formed a partnership to develop a series of watershed-based pilot projects. Phase I, completed in 2003, included six pilot projects that focused on new and innovative approaches to watershed stewardship. Phase II, with the objective to develop, implement and demonstrate place-based environmental management approaches, will provide some of the building blocks for the anticipated watershed-based drinking water source protection that will be undertaken in Ontario.

This is one of four pilot projects completed during Phase II seeking on the ground results, focusing on implementation, and the technical issues faced by practitioners when implementing drinking water source protection.

The full reports and fact sheets are available on Conservation Ontario's website.

The Project at a Glance...

Resource management agencies need to comprehend the complex inter-relationship between environmental health, local economy, and social conditions. The application of computer models has been widely accepted as the standard tool used by resource managers to predict the change in water quality associated with human activities and altered landscapes.

The Nutrient Management Pilot Project Summary Report and *CANWET Users Guide* describe the use of a leading edge initiative for modeling surface water budgets and nutrient loading.

In 2003, the Lake Simcoe Region Conservation Authority (LSRCA) retained Greenland International Consulting Ltd. to develop a surface water quality model for the management of nutrients, sediments and other contaminants in Ontario watersheds. The first phase involved the selection of an appropriate computer model that could be adapted for Southern Ontario conditions to:

- accurately determine the concentration of sediments and nutrients resulting from point and non-point source pollutants within a watershed, and
- predict potential reductions from the implementation of Best Management Practices (BMPs).

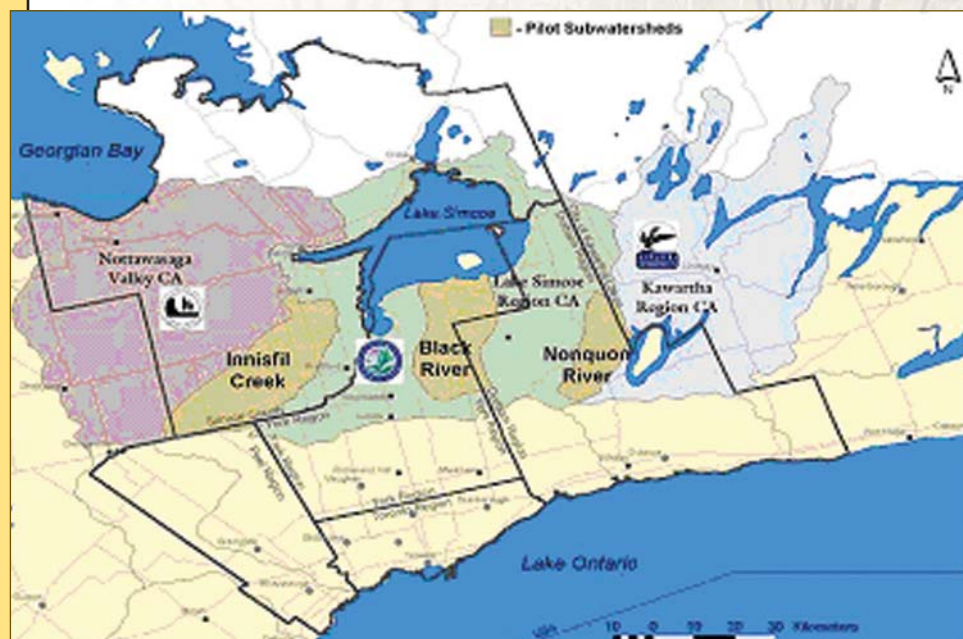
CANWET Model

The pilot project was completed using the first Canadian version of a modeling tool known as CANWET - **C**anadian **A**rcView **N**utrient and **W**ater **E**valuation **T**ool - based on the ArcView Generalized Watershed Loading Function (AVGWLF) model developed at Penn State University. CANWET incorporates modules for assessing nutrient and sediment loading and water balance within a GIS environment, and features a predictive modeling component for evaluating the implementation of both agricultural and non-agricultural pollution reduction strategies.

The model was pilot-tested in three Subwatersheds in southern Ontario with mixed urban/rural land uses, water use needs, and headwaters in the Oak Ridges Moraine: Innisfil Creek, Nonquon and Black Rivers.

The CANWET software is designed to assist the user to:

- Identify priority areas for restoration and remediation efforts;
- Calculate nutrient loading from rural areas within a subwatershed to the receiving waters;
- Evaluate the effectiveness of various watershed management practices; and
- Evaluate the impacts of future development and/or land use scenarios with respect to loading of nutrients to receiving waters.



Step 1: Selecting The Water Quality Model

Watershed simulation models are essential tools for source protection planning. A diverse range of analytical tools is available for simulating the concentration of various constituents in surface water resulting from both point- and non-point sources. From an initial list of nearly 50 hydrologic and water quality models, a short list was carefully selected by applying a set of "must have" characteristics that included:

- Ability to assist in developing total maximum daily load calculations for effluent discharge within the watershed areas;
- Use of GIS layer data as model input;
- Capability of providing a continuous, as opposed to event-based, simulation;
- Use of Microsoft Windows Operating System;
- Ability to assess future scenarios, i.e. to be used as a planning tool; and
- Ability to assess the impacts of abatement or Best Management Practices.

To choose a single model that would meet the needs of the largest number of users, end users of the model were surveyed for their input on the anticipated use and desired benefits from application of the selected model. They rated a list of proposed selection criteria that included usefulness and accuracy of data output, completeness and flexibility of the models, ease of use, user support requirements, cost, and ability to interface with other programs. In addition, survey respondents identified the most significant nutrient sources in the pilot watersheds, potential areas of data deficiency, and probable users of the selected model. Finally, the short-listed models were scored according to a decision support matrix developed by Greenland based on literature reviews. The AVGWLF model was chosen as the preferred model for use in the nutrient management pilot project.

Step 2: Setting Up The Model For The Pilot Watersheds

The adaptation of AVGWLF to CANWET for use in Southern Ontario - as well as other regions of Canada - involved a number of updates and modifications to account for unique features of the landscape that impact water balance and nutrient and sediment transport. New algorithms were created to account for the common use of tile drainage networks in Southern Ontario, the impacts of daily water extractions using data from the Ministry of the Environment's Permit To Take Water database, and increased potential for groundwater recharge associated with hummocky terrain. The Best Management Practice assessment tool in CANWET is based on the Pollution Reduction Impact Comparison Tool (PRedICT) module in AVGWLF. Adaptations were made to the tool based on available research for Ontario conditions concerning treatment efficiencies and BMP application costs.

The most time-consuming and technically demanding aspect of the pilot project involved the collection and processing of GIS data layers required to run the CANWET model. These data need continual updating as new information becomes available, to maintain a reliable representation of the pilot basins. Although the objective was to provide complete data sets for each pilot basin, there were known data gaps for which information was not available by the time the CANWET models were finalized. While the main purpose of integrating GIS into the model is to automate model parameterization, CANWET also allows for manual user input if better characterization is available for a specific study area than that provided in the pilot project GIS data layer.



Step 3: Model Application Results

After the CANWET model was run on the three pilot watersheds, an attempt was made to calibrate the model or assess the "goodness-of-fit" between observed water quality data and the simulated results in the pilot basins. Results from the Black Creek basin indicated a good fit between observed and predicted values. However, a lack of available monitoring data for the Nonquon River and Innisfil Creek prevented these watersheds from being calibrated. Limited monitoring data increases sensitivity to errors and contributes to poor agreement between observed and modeled results. The study concluded that CANWET will produce reliable results where sufficient quality input and calibration data is provided.

Next Steps: Future CANWET Model Development

The original algorithms used in CANWET were developed in the US more than 20 years ago and have been used successfully in hundreds of watershed management projects across North America and overseas. Adaptations to the model were developed for Southern Ontario conditions, and are in a process of continuous evaluation and improvement. Future versions of the model with new features and Canada-specific functionality will further advance the utility of the software and build on the successes of the pilot study.

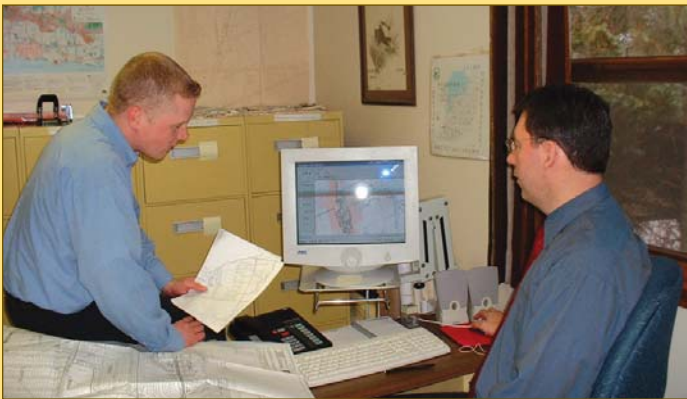
User's Guide

This pilot project is comprised of two parts:

1. Summary Report
2. User's Guide & CANWET model

The *Nutrient Management Pilot Project Summary Report* and this fact sheet are available on Conservation Ontario's website at www.conservation-ontario.on.ca.

In order to ensure that anyone using the CANWET model is provided with ongoing updates, users will need to request a copy of the User's Guide and model by registering with Conservation Ontario (see contact information noted below).



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