Development and Implementation of an Integrated and Sustainable Watershed Strategy through the Process of Adaptive Environmental Management

Le développement et l'application d'une stratégie de gestion intégrée et durable des bassins versants par un processus de gestion environnementale adaptative

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RESUME

La mise à jour d'un plan directeur de gestion des eaux de la Rivière Credit comporte une analyse du basin versant en tenant compte des interventions humaines ou naturelles (tel l'aménagement des terres ou le changement climatique). L'objectif de cette étude était d'évaluer et de sélectionner un plan qui a pour but d'assurer l'approvisionnement en eau abondante et saine, soit pour la population humaine ou pour la fauve dans le bassin versant de la Rivière Credit. Cette étude a tenu compte d'autres initiatives, tel le Oak Ridges Moraine Conservation Plan, Smart Growth et la 2e phase du rapport O'Connor. La question peut se poser ainsi: "Comment gérer la croissance espérée dans un encadrement écosystématique"? Le plan directeur a été réalisé par conciliation avec les multiples usagers – municipaux, provinciaux, académiques et individuels.

ABSTRACT

The Credit River Water Management Strategy Update used a decision support system to analyze the watershed's response to various stressors (land use and climate change scenarios). The goal was to evaluate and select a preferred management strategy that ensured "abundant, safe water" now and in the future for people and wildlife in the Credit River watershed. The study incorporated initiatives such as the Oak Ridges Moraine Conservation Plan, Smart Growth, Phase II O'Connor Report and other provincial initiatives to address the question "How much can we grow, and where/how can we grow from an ecosystem perspective? " The strategy was developed through working partnerships with municipalities, provincial agencies, academics and individual groups.

KEYWORDS

Adaptive Environmental Management, Impact Assessment, Implementation, Sustainable Development, Watershed Strategy.

1 INTRODUCTION

The main branch of the Credit River extends from the headwaters north of the Town of Orangeville to Lake Ontario at Port Credit (approximately 100km through the watershed). The Credit River watershed lies within the most densely populated region of Canada and supports a wide range of land uses including urban (23%), active/inactive agriculture (30%), forest (14%), pasture lands/old field (16%), wetlands (6%), and water bodies (4%). The drainage area of the watershed is approximately 1,000 km^2.

Despite historic and present land use changes, many parts of the Credit River watershed remain in a relatively healthy condition. The beauty of the area is enjoyed by thousands of hikers, tourists and sportsmen throughout the year. The southern reach of the Credit River is nationally recognized for its impressive fall runs of pacific salmon and rainbow trout (steelhead) which are stocked annually. Many parts of the northern section fo the watershed support self-sustaining cold water fish populations.

Anticipated growth within the watershed is considerable. According to the Ministry of Public Infrastructure and Renewal (2005) AND Places to Grow (ref 1), the two largest Regions are anticipated to grow by 60-100% in the next thirty years.

In light of these development pressures, it is critical to plan where growth occurs and how it will proceed. In such planning, the careful management of urban stormwater will be critical to protect public health. The objective of the Credit River Water Management Strategy (CRWMS) was to develop a decision support mechanism to implement upfront planning and sustainable management practices for various stressors such as future land use changes and climate change scenarios. The goal was to select a management strategy that ensures “abundant, safe and clean water” now and in the future for both the people and wildlife within the Credit River watershed.

2 METHODS

The Credit River Valley Conservation’s (CVC’s) approach to managing proposed development involves a number of steps. CVC together with the 11 member municipalities jointly provide input to Official Plans and Infrastructure Renewal Plans. Furthermore, a comprehensive monitoring program has been undertaken in order to evaluate how the watershed will respond to various stressors such as development, climate change, and human activities (water takings, aggregate extraction etc.).

Comprehensive watershed wide studies are also undertaken periodically in order to provide a decision-making framework. The initial watershed study was undertaken in the late 80’s through early 90’s. this study was initiated in the fall of 2003 and completed in the summer of 2006.

Through the use of scientific studies the CVC and partner municipalities can then identify and implement the best management strategy to protect public and environmental health. Long term monitoring can then evaluate the effectiveness of management decisions. Using an iterative approach to watershed management allows CVC and its municipalities to use Adaptive Environmental Management (AEM) techniques to respond and protect the environment. The premise of AEM is to define clear, measurable goals and develop a model, such as a watershed framework, to develop an understanding of watershed functions and relationships.

The methods/techniques used in this study initially involved the development of an integrated set of study goals and objectives which were then linked to a series of measurable parameters and targets at 20 representative locations throughout the

watershed. Examples of objectives used to evaluate existing and future scenarios included:

- Minimize risk to human life and property due to flooding
- Protect groundwater quality to support watershed functions
- Improve water quality in rivers and Lake Ontario for body contact recreation
- Protect, restore or enhance the integrity of the watershed ecosystem through an integrated network of natural areas, habitat and connecting links

Integrated surface (Hydrolic Simulation (HSPF)) (ref 2) and groundwater (Finite Element Flow (FEFLOW)) (ref 3) models were then used to establish existing environmental conditions and to simulate various stressors for different land use conditions and Management Alternatives (a Management Alternative si defined as a set of Best Management Practices (BMP's) which, when implemented collectively, will attempt to address the impacts associated with urbanizing areas as well as those that presently exist). As is illustrated below, the Management Alternatives range from Do Nothing, to continuing present practices, to implementing an aggressive and comprehensive approach which has not been tried within Canada. The land use scenarios that were modeled included:

- 2006 – existing conditions (15% urbanization)
- 2051 – future land use conditions (25% urbanization)

The Management Alternatives that were applied to the 2051 land use scenario included:

- **Do Nothing:** Absence of any stormwater BMP's in urbanizing areas
- **Business as Usual:** Continuing with current Best Management Practices
- **Technology and Economic Driven:** Overcome current technical and economic barriers which limit implementation of Best Management Practices
- **Ecotopia:** Greater consideration of the environment in land use planning and aggressive stormwater management

Also included in the technical assessment was the retrofitting of existing land use. Examples of retrofitting included disconnecting roof leaders, installing rain barrels, tree planting, upgrading municipal infrastructure and wastewater treatment plants, etc.

3 RESULTS AND DISCUSSION

The study objectives, measurable parameters and targets (4000 in total) were initially used as a basis to screen out acceptable Management Alternatives (MAs which resulted in conditions equal or better than existing conditions were deemed to be acceptable). A subsequent set of social, economic, and environmental criteria were then used to select the Preferred Strategy.

Some of the key findings are summarized below. The findings are also presented graphically in the accompanying figures.

- Existing watershed conditions show some degradation in the environment, (refer to Figure 1)
- Current planning and development practices are not sustainable (refer to Figure 2).
- Growth can occur in a sustainable manner if we change current planning and development practices and implement aggressive stormwater management per the Ecotopia management alternative (refer to Figure 3).

- Restoration of existing rural and urban land uses is critical to maintain and restore existing environmental conditions within the watershed.

Ecotopia for new development involves stormwater management controls at the site level (i.e. bioretention cells, rain gardens, street swales, green roofs, tree box filters, etc.) to mimic predevelopment hydrology-enhancing evapotranspiration, infiltration and storage to manage stormwater quantity, temperature and quality. Furthermore, the form and layout development recognizes environmental features such as wetlands, mature forests, steep slopes, and riparian buffers to maintain predevelopment hydrology and minimize the amount of impervious cover by reducing road widths, sharing driveways, limiting sidewalks to one side of the road, utilizing curbless roads, pervious driveways, and discouraging street layouts such as cul-de-sacs (which increase impervious area), etc. Ecotopia for existing lands includes working with homeowners and businesses to adopt similar approaches as noted above. It also involves working with municipal staff to ensure replacement of infrastructure reflects the environment principles as laid out in the document. It also involves dealing with farmers, special interest groups and agencies to restore degraded areas within the watershed. In comparison to existing conditions implementation of the Ecotopia Management Alternative (the Preferred Strategy) would result in:

- Improved water quality
- Reduced flood risks
- Improved conditions for fishery, wildlife
- Enhanced groundwater supply

4 SUMMARY AND CONCLUSION

One of the key conclusions that was arrived at during the course of the study was that current development practices are not sustainable, we therefore need to change the way we do things if growth is to continue. Furthermore, we need to restore (retrofit) existing rural and urban landuses if we wish to maintain, enhance or restore environmental conditions within the Credit River watershed.

The question then becomes; how do we implement change for new development? And, how do we change our approach and find funding alternatives needed to restore/retrofit existing rural and urban areas?

Change, in the context of this study refers to a number of items, including:

- Changing the mindset of consultants, municipalities, developers and agencies with respect to the current approach for undertaking stormwater management;
- The requirement to develop a progressive approach for integrating stormwater management measures into subdivision/site planning design;
- Revisiting/modifying existing municipal and agency policies and standards;
- Initiating pilot projects for stormwater management measures (e.g. green roofs, roof downspout disconnection, filtration systems, alternative municipal infrastructure systems) which have not yet been proven in Ontario;
- Considering alternative sources of funding for the proposed measures in order to ensure that the requirements as outlined are funded in a sustainable manner;
- Consideration of incentives (credits) for progressive submissions.

As a result of undertaking this study a number of key recommendations were provided. These recommendations provide a framework for developing the

Implementation Plan. The recommendations, which incorporate key components of the study are summarized as follows:

- Principle - Recognize rainwater, groundwater and snowmelt as valuable resources; manage rain where it falls - on lots and streets – before it enters sewers and streams.
- Targets - Formally adopt the Strategy goal, principles, objectives, measurable parameters and targets as a basis for future municipal endeavours
- BMP Measures - Implement a hierarchy of water quality/quantity BMP's in all new development and redevelopment undertakings as well as existing landuses using a full range of potential source, conveyance and end-of-pipe controls and restorative measures consistent with the recommended strategy.
- Policy/Standards - Ensure municipal planning and development policies, guidelines, processes and standards incorporate an integrated ecosystem approach that draws on the collective expertise and experience of planners, engineers and landscape architects.
- Funding - Initiate the necessary programs/policies to staff and fund a range of retrofit and restorative measures within existing urban and rural areas as recommended in the Strategy.
- Administration - Put in place an appropriate administrative structure to guide and oversee Strategy implementation and actively contribut to the work of the Management Steering Committee (MSC) and Working Groups (WGs).

With respect to the last point a series of Working Groups involving CVC staff, municipalities, developers, consultants, and stakeholders and other specialty groups have been formed. These groups are working cooperatively to ensure the components as noted above, are implemented successfully.

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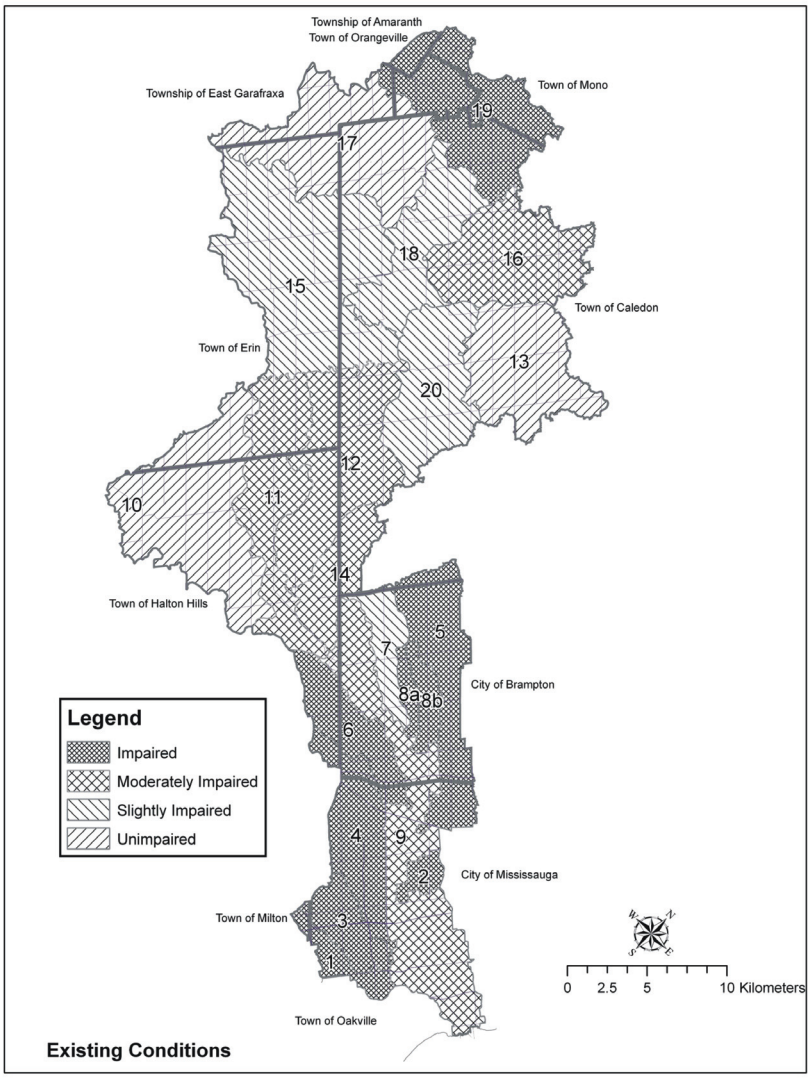

Figure 1 – Existing Environmental Conditions within the Credit Valley Watershed

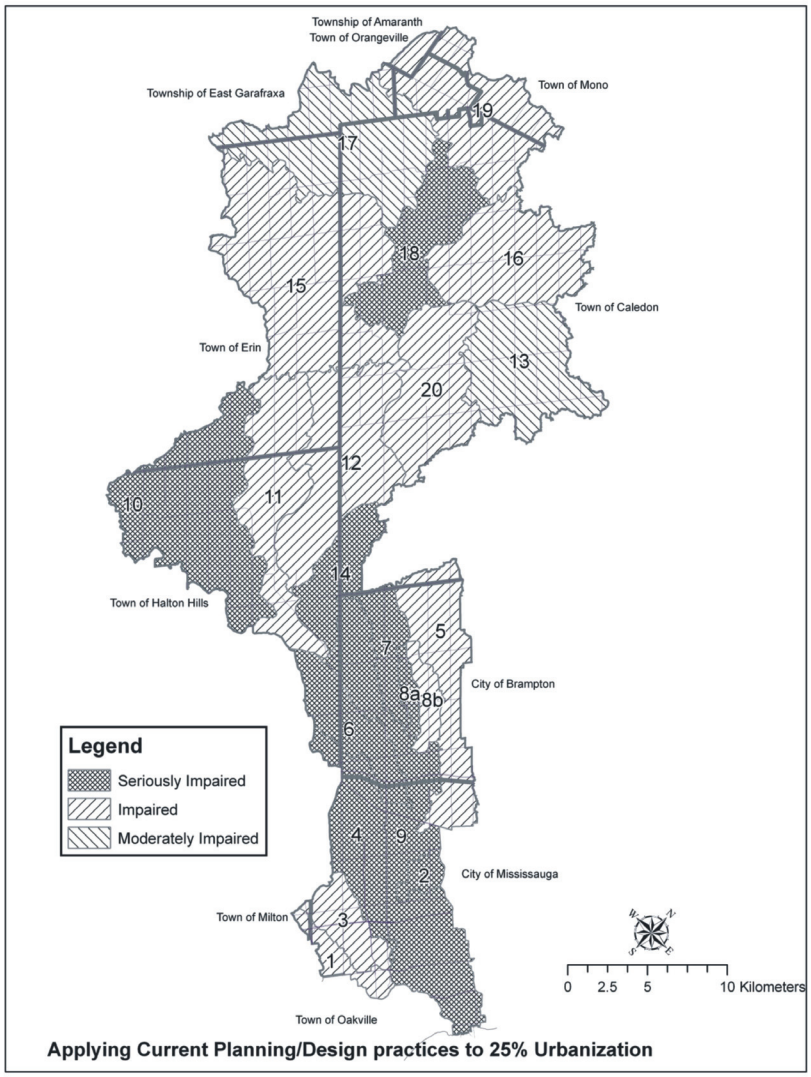

Figure 2 – Environmental Conditions within the Watershed applying Business as Usual Practices and Retrofitting Existing Land Uses (at 25% Urbanization)

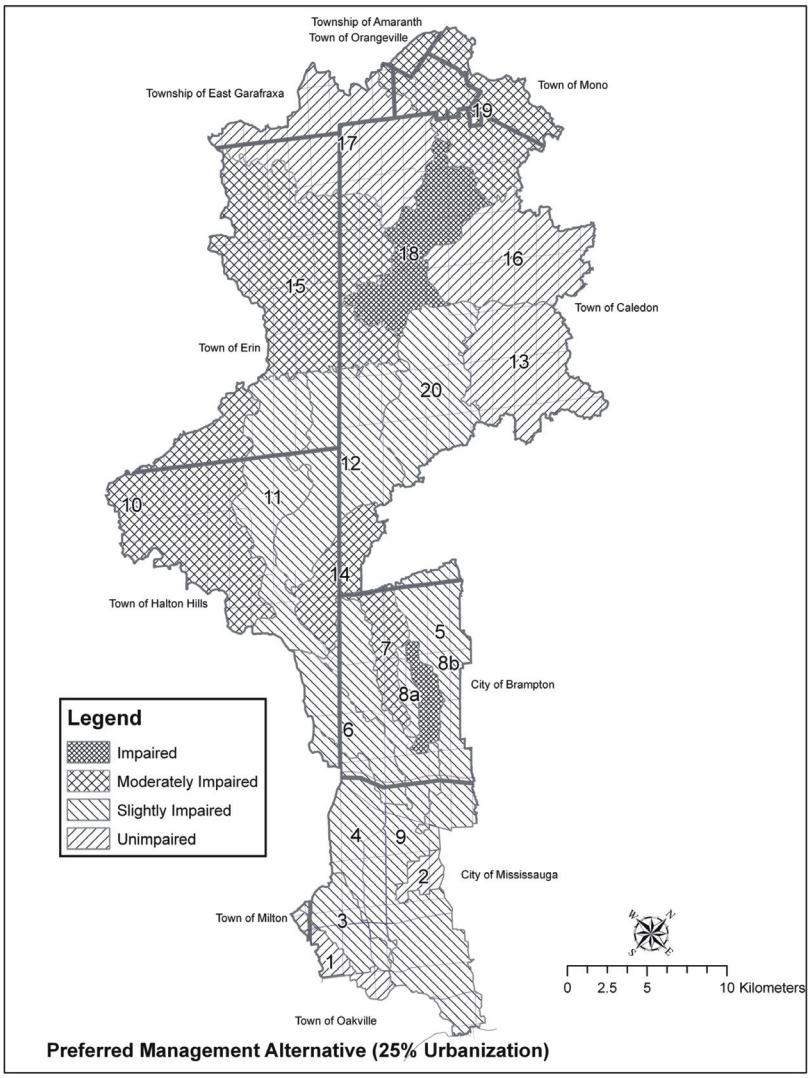

Figure 3 – Environmental Conditions within the Watershed applying Ecotopia and Retrofitting Existing Land Uses (at 25% Urbanization)