

Paper Title:

POTENTIAL IMPACTS OF CLIMATE CHANGE ON STORMWATER

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Mike received his Ph.D. (Environmental Engineering) and M.Sc. (hydrology) from Queen's University and he presently leads the Water Resources Group of XCG. Mike is a former faculty member of the Royal Military College in the department of Civil Engineering and he has extensive surface water and groundwater project and R&D experience. Mike has worked throughout North America on a broad range of projects and his experience and expertise includes hands-on development and application of numerical models addressing both surface water and groundwater issues. Mike has developed several numerical tools designed to support the design of stormwater treatment facilities. Currently, Mike is working on a revised water balance model designed to support the preliminary design of low-impact development measures for urban development.

Abstract:

This paper provides an overview of the potential impacts of climate change on stormwater management practices in southern Ontario. A synopsis of the recent (2007) findings of the United Nations Intergovernmental Panel on Climate Change, the IPCC, is presented to illustrate both the anticipated changes in climate, in terms of precipitation, temperature, and event frequency, as well as the uncertainty associated with climate change projections. The review of the 2007 IPCC work provides the necessary background for the assessment of climate change and stormwater management. Although large uncertainties are associated with all climate change projections, the 2007 IPCC results indicate that in southern Ontario over the next century, average annual temperatures will increase more than the global average, total annual precipitation will increase, and the number of dry-days will increase marginally. Therefore, less frequent, more intense rainfall events are a distinct possibility in the near future.

Evaluating the implications of potential climate change on stormwater management requires an understanding of historical stormwater management practices. Prior to 1970, the principal problem was increased runoff volumes in developing areas and the solution was to rapid drainage. Between 1970 and 1990, downstream flooding and erosion were the key problems and constructed storage was the popular solution, while from 1990 to the present,

water quality impacts, as well as flooding and erosion concerns were addressed using a wide range of urban BMPs. For the future, the emphasis appears to be on achieving a post-development water balance that is consistent with pre-development conditions.

Clearly, stormwater management practices have not been static and there is no reason to expect that we have reached the ultimate solution. The potential impact of climate change on stormwater infrastructure depends on the magnitude of the expected change and the type of infrastructure. Based on anticipated climate change, it is reasonable to assume that pipe diameters and storage volumes will need to increase. However, other externalities and non-climate related issues must be considered as well. For example, population growth, aging infrastructure, and changing public perceptions and expectations may all impact stormwater management to an extent equal or greater than climate change.

Important climate variables to be investigated for climate change include intensity-duration-frequency relationships, design storm characteristics, antecedent conditions, critical rain plus snowmelt sequences and critical temperature sequences. In general, existing design criteria and methodology need to be re-examined in light of potential climate change. In many cases, current approaches do not reflect advances in science or best available technology, and therefore climate change should be addressed as one of several uncertainties.

As demonstrated by recent investigations by IPCC and others, it is reasonable to accept that climate is non-stationary and as a consequence, stormwater design criteria should be explicitly related to uncertainty or risk as is common in other design fields of civil engineering. Furthermore, some consideration to adaptive planning and design, providing some overcapacity for example, may represent a prudent additional measure.