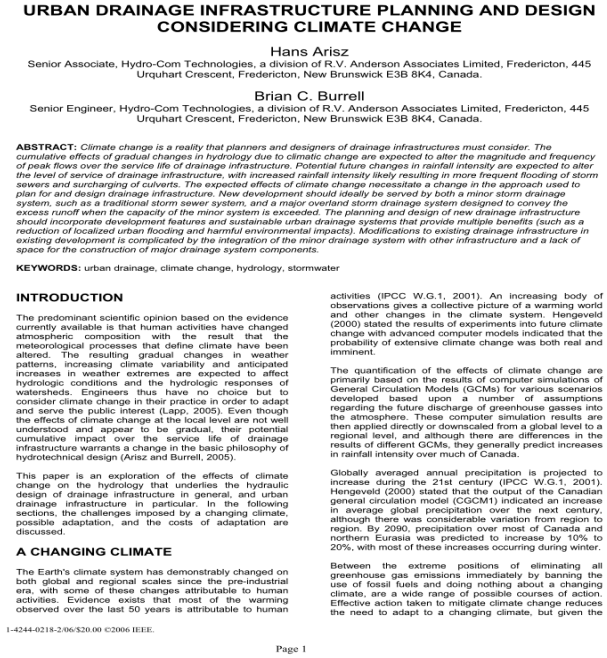
Impacts of Climate Change on Rainfall Extremes and Urban Drainage Systems



URBAN DRAINAGE INFRASTRUCTURE PLANNING AND DESIGN CONSIDERING CLIMATE CHANGE

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ABSTRACT: *Climate change is a reality that planners and designers of drainage infrastructures must consider. The cumulative effects of gradual changes in hydrology due to climatic change are expected to alter the magnitude and frequency of peak flows over the service life of drainage infrastructure. Potential future changes in rainfall intensity are expected to alter the level of service of drainage infrastructure, with increased rainfall intensity likely resulting in more frequent flooding of storm sewers and surcharging of culverts. The expected effects of climate change necessitate a change in the approach used to plan for and design drainage infrastructure. New development should ideally be served by both a minor storm drainage system, such as a traditional storm sewer system, and a major overland storm drainage system designed to convey the excess runoff when the capacity of the minor system is exceeded. The planning and design of new drainage infrastructure should incorporate development features and sustainable urban drainage systems that provide multiple benefits (such as a reduction of localized urban flooding and harmful environmental impacts). Modifications to existing drainage infrastructure in existing development is complicated by the integration of the minor drainage system with other infrastructure and a lack of space for the construction of major drainage system components.*

KEYWORDS: urban drainage, climate change, hydrology, stormwater

INTRODUCTION

The predominant scientific opinion based on the evidence currently available is that human activities have changed atmospheric composition with the result that the meteorological processes that define climate have been altered. The resulting gradual changes in weather patterns, increasing climate variability and anticipated increases in weather extremes are expected to affect hydrologic conditions and the hydrologic responses of watersheds. Engineers thus have no choice but to consider climate change in their practice in order to adapt and serve the public interest (Lapp, 2005). Even though the effects of climate change at the local level are not well understood and appear to be gradual, their potential cumulative impact over the service life of drainage infrastructure warrants a change in the basic philosophy of hydrotechnical design (Arisz and Burrell, 2005).

This paper is an exploration of the effects of climate change on the hydrology that underlies the hydraulic design of drainage infrastructure in general, and urban drainage infrastructure in particular. In the following sections, the challenges imposed by a changing climate, possible adaptation, and the costs of adaptation are discussed.

A CHANGING CLIMATE

The Earth's climate system has demonstrably changed on both global and regional scales since the pre-industrial era, with some of these changes attributable to human activities. Evidence exists that most of the warming observed over the last 50 years is attributable to human activities (IPCC W.G.1, 2001). An increasing body of observations gives a collective picture of a warming world and other changes in the climate system. Hengeveld (2000) stated the results of experiments into future climate change with advanced computer models indicated that the probability of extensive climate change was both real and imminent.

The quantification of the effects of climate change are primarily based on the results of computer simulations of General Circulation Models (GCMs) for various scenarios developed based upon a number of assumptions regarding the future discharge of greenhouse gasses into the atmosphere. These computer simulation results are then applied directly or downscaled from a global level to a regional level, and although there are differences in the results of different GCMs, they generally predict increases in rainfall intensity over much of Canada.

Globally averaged annual precipitation is projected to increase during the 21st century (IPCC W.G.1, 2001). Hengeveld (2000) stated that the output of the Canadian general circulation model (CGCM1) indicated an increase in average global precipitation over the next century, although there was considerable variation from region to region. By 2090, precipitation over most of Canada and northern Eurasia was predicted to increase by 10% to 20%, with most of these increases occurring during winter.

Between the extreme positions of eliminating all greenhouse gas emissions immediately by banning the use of fossil fuels and doing nothing about a changing climate, are a wide range of possible courses of action. Effective action taken to mitigate climate change reduces the need to adapt to a changing climate, but given the

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Water Sci Technol. ;68(1) doi: /wst Impacts of climate change on rainfall extremes and urban drainage systems: a review.Climate Change Impacts on Rainfall Extremes and Urban Drainage: a in urban rainfall extremes and their effects on urban drainage systems.Impacts of climate change on rainfall extremes and urban drainage Under global warming, extreme weather such as rain- storms (Zhang et .. trends in urban rainfall extremes and their effects on urban drainage systems.Issue 6. Impacts of Climate Change on Rainfall. Extremes and Urban Drainage Systems. A book review. Edited by P. Willems, J. Olsson, K. Arnbjerg-Nielsen.rainfall extremes as well as on urban hydrology and Climate change impacts on urban drainage: results . volumes (depending on systems characteristics).Impacts of Climate Change on Rainfall Extremes and Urban Drainage Systems provides a state-of-the-art overview of existing methodologies.Impacts of climate change on rainfall extremes and urban drainage systems: a review. K. Arnbjerg-Nielsen. K. Arnbjerg-Nielsen. 1. Technical.Madsen, H & Nguyen, V-T-V , 'Impacts of climate change on rainfall extremes and urban drainage systems: a review', Water science and technology, vol.Impacts of Climate Change on Rainfall Extremes and Urban Drainage Systems The impact of climate change on the increased vulnerability of cities to floods.Adaptation response: Urban storm water management. Description Impacts of climate change on rainfall extremes and urban drainage systems: a review.to efficiently improve the urban drainage system in light of climate change. [8] simulated and analyzed the effects of extreme rainfall on [12] suggested approaches to quantify the impact of climate changes on extreme.Willems et al., Limitations and Pitfalls of Climate Change Impact Analysis rainfall extremes and their effects on urban drainage systems, due to anthropogenic.Buy the Impacts Of Climate Change On Rainfall Extremes And Urban Drainage Systems (ebook) online from Takealot. Many ways to pay. Free Delivery.IMPACT OF CLIMATE CHANGE ON URBAN DRAINAGE SYSTEM period with regard to rainfall extremes and (ii) the transfer of climate predictions to fine.hydrological extremes along rivers and urban drainage systems in Belgium. Phase 1: Development of climate change scenarios for rainfall and ETo. SUMMARY.Analyses of the impact of climate changes on urban drainage systems carried out Description of new extreme climate proof design rainfall (DANVA, A).to extreme rainfall with open urban drainage system An integrated hydrological increasing flood hazards and risks due to climate change impacts. Although.Change Impacts on Surface Flooding in a Peri-Urban Area of. Pathumthani, Thailand urban drainage system and hydraulic performance affected by urban rainfall extremes using climate projections from GCMs. (e.g. Semadeni-Davies et al.Impacts of climate change on rainfall extremes and urban drainage systems [electronic resource]. Responsibility: Patrick Willems [et al.]. Imprint: London: IWA.In addition, severe intensity rainfall events can cause failure of drainage system capacity and subsequent urban flood inundation problems (Beecham.

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