THE IMPACT OF URBAN AND SUBURBAN LAND USE CHANGE ON STREAM DISCHARGE: THE WEST BRANCH OF THE DUPAGE RIVER 1962-1983

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ABSTRACT

This study used four techniques to evaluate the changes in four streamflow characteristics in the West Branch of the DuPage River, in order to test the hypothesis that variations in streamflow that are unrelated to discharge in a basin undergoing urbanization most likely occur as result of land use changes. The very northern reaches of the West Branch of the DuPage River were studied because this 11.5 mile length of stream had experienced a significant land use change between 1962-1983, it had no artificual obstruction to natural streamflow, it was a "manageable" size (28.5 square miles), and it had a continuously recording United States Geological Survey gaging station. Time series and trend analyses, flow-duration curves, double-mass curves and the climatic water budget were the techniques used to evaluate changes in annual, monthly, high and low flows.

Two of the techniques, time series/trend analyses and double-mass curves, produced results that provided a general indication of the changes in streamflow characteristics. These two techniques were useful in establishing trends and provided a basis for evaluating the discharge changes. The flow-duration curves and the climatic water budget, however, provided a means of eliminating the influence of precipitation on discharge, and therefore, offered a more detailed evaluation of the effect of urban land uses changes on streamflow characteristics.

The study revealed that between 1962 and 1983 high, low, annual and monthly flows all increased. Some of the increasing flows were a result of higher average rainfall in the latter half of the study period, but the flow-duration curves and the climatic water budget indicated that changes in annual and monthly high and low flows were at least partly the result of urbanization.

The flow-duration curve analysis was especially useful in the examination of low flow changes, and showed that low flows in the last five years of the study were much higher than in the first five years. Moreover, a subsequent analysis of precipitation patterns strongly suggested that the low flow changes were not due to precipitation. A study of the physical and cultural characteristics of the basin led to the conclusion that the alterations in low flows were the result of increased sewage treatment plant discharges.

The climatic water budget was most useful in separating the influence of climate on streamflow, and allowing an evaluation of the changes that resulted from urbanization. Annual and monthly streamflow volumes, after accounting for precipitation, indicated that the increases in discharge were attributed to greater overland runoff (impervious surfaces and storm sewers) and sewage treatment plant discharges during the study period. Based largely on conclusions drawn from the flow-duration curves and the climatic water budget, the hypothesis was accepted that variations in streamflow within an urbanizing watershed that are unrelated to fluctuations in precipitation most likely resulted from land use changes associated with urban development.