AN APPLICATION OF A COMPUTERIZED MATHEMATICAL MODEL FOR ESTIMATING THE QUANTITY AND QUALITY OF NONPOINT SOURCES OF POLLUTION FROM SMALL URBAN AND NONURBAN WATERSHEDS

BY

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RESEARCH REPORT

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ABSTRACT

The problem of "Total Water Management" is reviewed; particular emphasis is given to the magnitude and intensity of pollution from nonpoint sources. The relationship between land usage in south Florida and subsequent effects upon receiving water bodies is discussed. Basic factors effecting hydrological and ecological subsystems are illustrated.

The U.S. Army Corps of Engineers Urban Storm Water Runoff Mathematical Model, "STORM," is introduced. Model parameters and methology are discussed. The mathematical relationships and modeling processes are reviewed and the model is exercised using a "new generation" southeast Florida community (The City of Palm Beach Gardens) as the subject of study.

It is concluded that the model can be beneficial in supporting estimates of pollutant loading to receiving waters from nonpoint sources. Iteration with the model, varying control facility cost and capacity, provides a cost effective tool for land and water resource planners. However, due to the particular nature of soils, atmospheric and urban conditions in south Florida, the model should be calibrated with input constants and default values derived to more accurately reflect the southeast Florida environment.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Background

The continuance of rapid development along the southeastern coast of Florida has promulgated Pollution Control and Public Health Authorities to apply stringent measures to safeguard the environmental well being and quality of life in this region. In reaction to increased pressure on health and environmental standards, State and Federal recognition has surfaced in the form of a multitude of legislative vehicles to establish and support "Total Water Quality Management."

In response to this interest and support, local southeast Florida governmental agencies have been commissioned to apply technology and funding to the problem. Regional water management agencies ranging from highly local entities, such as The Loxahatchee River Environmental Control District,[1] (in northern Palm Beach County) to county wide bodies, (Palm Beach County Area Planning Board) and multi county, (Central and Southern Florida Flood Control District) are directly concerned.

Initially, local city and county efforts were directed towards solving problems concerned with obvious and recognizable "Point Sources" of pollution. These efforts resulted in the emergence of regionalized wastewater pollution control and abatement projects. With the availability of Environmental Protection Agency funding,[2] many of the smaller

and less efficient sewage treatment plants serving the mushrooming southeast Florida Communities, are being replaced by centralized sewage collection and treatment facilities to reduce the threat to ground and receiving waters as well as lower the overall cost of treatment and transmission.

However, with these primary efforts beyond the "planning stage," increased attention is being focused on other pollutant sources within the "Total Water Management" spectrum. These sources fall into the realm of "Nonpoint" sources of pollution--the threat to ground and receiving waters stemming from agricultural, silviculture, construction, mining and urban runoff which are, for the most part, not now being managed or controlled. Typical nonpoint sources of pollution include stormwater drainage, agricultural irrigation practices, and watershed backpumping to maintain desired water levels in such supply bodies as Lake Okeechobee.

Objectives

This paper will be concerned with a specific nonpoint pollutant source, i.e. stormwater runoff from a predominantly urban situation. It will apply the U.S. Army Corps of Engineers "STORM" (Urban Storm Water Runoff Model)[3] as a method to estimate the quantity and quality of pollutant runoff to a receiving water body from successive storms. The subject of the study will be a typical "new generation" southeast Florida community, the City of Palm Beach Gardens, Palm Beach County, Florida.

CHAPTER II

THE PROBLEM OF STORMWATER RUNOFF

An estimated 30% of the total water budget in the United States consists of surface water runoff. This approaches 100% with respect to urban areas.[4] The significance of this is reflected in the fact that wet weather urban effluents are transmitted at almost full strength to receiving water bodies. Extensive land clearing with subsequent construction provides stormwater runoff with heavy concentrations of silt and sediment. Agricultural runoff further contributes pesticides, herbicides, pathogenic organisms, biochemical oxygen demand and dissolved or suspended elements of Arsenic, Nitrogen, Phosphorus and Potassium, as well as sand and silt. Some basic characteristics identified with surface runoff include:

A. Potential pollutant concentrations vary with many factors, however, rainfall over time (stochastic nature of rainfall) and ground cover, or land use are probably the most important.

B. The greatest amount of particulate material delivered to receiving waters occurs near or at time of peak hydraulic discharge.

C. The first flush of stormwater flow tends to carry the highest concentration of pollutant load and