

LAND USE, RUNOFF AND RECHARGE ON
SELECTED WATERSHEDS IN THE U.S. VIRGIN ISLANDS

by

Henry Smith
Owolabi Ajayi

Project No. A-012-VI
Agreement No. 14-34-0001-2150

September 1983

The work upon which this report is based was supported in part by funds provided by the United States Department of the Interior, as authorized by the Water Research and Development Act of 1978

Technical Report No. 13
Caribbean Research Institute
College of the Virgin Islands
St. Thomas, USVI 00802

DISCLAIMER

Contents of this publication do not necessarily reflect the views and policies of the U. S. Department of the Interior, nor does mention of trade names or commercial products constitute their endorsement or recommendation for use by the U.S. Government.

ABSTRACT

Three watersheds with different land use characteristics on St. Thomas, Virgin Islands were instrumented and monitored to study the effects of various land use patterns on runoff and groundwater recharge. The water crop (combined runoff and groundwater recharge) for each watershed was calculated using two different methods and the runoff determined independently using a Soil Conservation Service method. While results illustrated the effect of different land uses on recharge, the wide discrepancies in results according to the method applied highlighted the need for extensive data collection for such a study to be conclusive.

ACKNOWLEDGEMENTS

We would like to express our appreciation to those who assisted us in carrying out this project to completion. In particular Mr. Pedro Diaz of the Caribbean District Office of The United States Geological Survey in Puerto Rico provided us with some of the daily water level records. Mr. Clement Browne and Mr. Philmore Andrew, student research assistants at the Caribbean Research Institute, tirelessly monitored campus rainfall and water levels. The typing of the final document was a burdensome task well executed by Ms. Medina Rogers and Ms. Cynthia Rymer of the Caribbean Research Institute.

TABLE OF CONTENTS

ABSTRACT	iii
ACKNOWLEDGEMENTS	iv
LIST OF FIGURES	vi
LIST OF TABLES	vii
I INTRODUCTION	1
Location	1
Need for Study	5
Methodology	6
II FACTORS INFLUENCING RECHARGE	9
Rainfall	9
Evapotranspiration	9
Groundwater and Geology	12
Soils	17
III STUDY SITES	18
Lockhart Elementary School Study Site	18
College of the Virgin Islands Study Sites	37
IV CONCLUSIONS AND RECOMMENDATIONS	53
V REFERENCES	55

LIST OF FIGURES

Figure		Page
1	Location of St. Thomas, Virgin Islands	2
2	Rainfall Running Average, Accumulated Departure from the Average and Annual Rainfall at Charlotte Amalie, St. Thomas	11
3	Precipitation and Evapotranspiration at Charlotte Amalie, St. Thomas	13
4	Generalized Geologic Map of St. Thomas	15
5	Estimated Recharge to Groundwater Areas in St. Thomas	16
6	Lockhart Elementary School Study Site	19
7	Rainfall and Groundwater Levels at Lockhart Elementary School Study Site	30
8	Location Map of College of the Virgin Islands Study Sites	38
9	General Soils Map	40
10	Rainfall and Groundwater Levels at CVI Study Area	47

LIST OF TABLES

Table		Page
1	Supply of Water Available from Various Sources in St. Thomas, 1979	10
2	Ultimate Disposition of Rainfall	14
3	Engineering Classification and Estimated Soil Properties in Lockhart Elementary School Study Area	21
4	Water Level and Rainfall Data for Lockhart Elementary School Study Site	24
5	Lockhart Elementary School Runoff Calculations and Estimates, January to September 1983	34
6	Engineering Classification and Estimated Soil Properties in College of the Virgin Islands Study Area	41
7	College of the Virgin Islands, St. Thomas Rainfall October 1982 to September 1983	43
8	Groundwater Production at CVI Study Sites, 1982-1983	44
9	Site I: Reichhold Center Rainfall-Runoff Calculations October 1982-September 1983	46
10	Site II: Golf Course Rainfall-Runoff Calculations October 1982-September 1983	49
11	Summary of Hydrological Conditions at the College of the Virgin Islands Study Sites	51

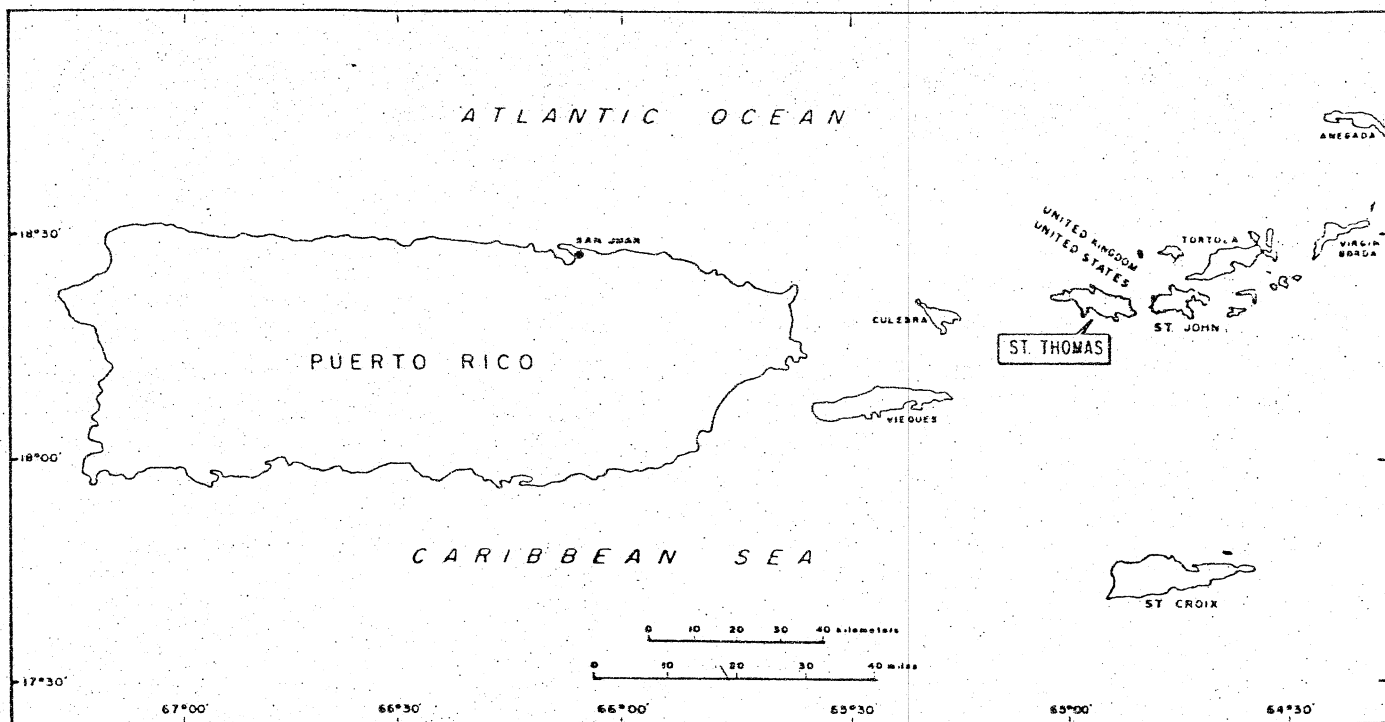
INTRODUCTION

Location

The United States Virgin Islands is an unincorporated territory of the United States located in the Caribbean Sea, approximately 1,100 miles east-southeast of Miami, Florida and 500 miles northeast of Caracas, Venezuela. The U.S. Virgin Islands consists of three large islands and more than forty small islands and cays. The three largest inhabited islands; St. John, St. Thomas, and St. Croix, have respective land areas of approximately 19, 32, and 84 square miles. All of the islands are characterized by steep rocky mountains of volcanic origin. The islands also display diverse ecological systems ranging from beaches and dry thorn scrub of the lowlands to the deciduous forests of the higher elevations.

St. Thomas is the second largest of the three major islands of the U.S. Virgin Islands and is located 50 miles east of Puerto Rico, (See Figure 1). The island is approximately 19 miles long and 2 to 3 miles wide. Flat land is generally rare on St. Thomas for most of the land surface is sloping and extends seaward

Figure 1



Location of St. Thomas, Virgin Islands

from a central ridge, 800 to 1,200 feet high, that runs almost the entire length of the island. The flat areas are found for the most part in Charlotte Amalie, the seat of government of the Virgin Islands, and a few alluvial-filled embayments. These embayments are seldom more than a few acres in area with the thickness of the alluvial deposits at a maximum being generally less than 50 feet.

In addition to rain water harvesting, groundwater is the only other significant "natural" water source on St. Thomas. Surface water supplies are negligible. As a result of the topography none of the streams in St. Thomas are truly perennial. Bonne Resolution Gut and Turpentine Run in the north and eastern parts of the island respectively, although often described as perennial, have been known to go dry during extreme drought periods. It has been estimated that in the perennial reaches of these streams about one-half to three-fourths of the flow is storm runoff and the remainder is base flow contributed by groundwater. (1)

Groundwater, though not abundant, is withdrawn throughout the island in varying amounts. In St. Thomas most of the groundwater occurs in fractured rocks, joints and fault zones. The major portion of the island is underlain principally by fractured volcanic tuff and breccia of the Louisenhoj Formation. Soil depths of one to two feet have developed in this formation. While the underlying bedrock, especially in the flat areas, has