SUPPORTING REPORT C

HYDROLOGICAL ANALYSIS

SUPPORTING-C : HYDROLOGICAL ANALYSIS

TABLE OF CONTENTS

SUPPORTING C : HYDROLOGICAL ANALYSIS

LIST OF TABLES

SUPPORTING C : HYDROLOGICAL ANALYSIS

LIST OF FIGURES

SUPPORTING-C
HYDROLOGICAL ANALYSIS

1. GENERAL

1.1 INTRODUCTION

This is the supporting report for the project entitled "The Study on Flood Control and Landslide Prevention in Tegucigalpa Metropolitan Area in the Republic of Honduras".

The hydrological/hydraulic study area covers the area in the following basins:

- The Choluteca river basin in Tegucigalpa,
- The Grande river basin,
- The San Jose river basin,
- The Guacerique river basin and
- The Chiquito river basin.

These drainage basins are shown in *Figure C.1.1*.

1.2 OBJECTIVES AND SCOPE

The content of this Supporting Report was divided into 2 stages; hydrological analysis and hydraulic simulation.

1.2.1 HYDROLOGICAL ANALYSIS

Objectives of the hydrological analysis are to clarify the relationship of the rainfall and its return period and the runoff generated by the rainfall in each basin.

The scope of work covered the hydrological works as follows:

- Frequency analysis and
- Rainfall-runoff analysis.

The frequency analysis was conducted to clarify the relationship of rainfall and its return period, by using the standard Gumbel method.

The rainfall-runoff analysis was then conducted to calculate the runoff during flood period generated by the maximum or design rainfall. A storage function method with the Newton – Ralpson interpolation was employed for this analysis.

1.2.2 HYDRAULIC SIMULATION

Objective of the hydraulic simulation is to clarify the flow characteristics of the Choluteca river basin in Tegucigalpa including peak water level, peak flow rate and hydrograph in various river and boundary conditions.

The scope of work covered the river modeling and the hydraulic simulation by using the data from topographic and river survey by the JICA Study Team in 2001 in order to obtain accurate data.

1.3 GENERAL HYDROLOGICAL CONDITION

The hydrological and hydraulic study area covers 5 drainage basins in Tegucigalpa and its southern part; the Choluteca, the Grande, the Guacerique, the San Jose, the Chiquito river basin. The climate in this area is as follows:

Average maximum temperature	:	29 °C
Average minimum temperature	:	17 °C
Average temperature	:	23 °C
Evaporation	:	670 mm/year

Rainfall is slightly different in each basin and shown in the next chapter.

1.4 LITERATURE REVIEW

There are some hydrological studies conducted in the area. The related studies are described in the following text briefly.

1.4.1 FLOOD CONDITION AND DAMAGE SURVEY BY USGS

The USGS conducted a preliminary flood condition and damage survey after the Hurricane Mitch in 1998. The sequence of flood damage was as follows:

Table C.1.1 Flood Condition and Damage during the Hurricane Mitch

Date	Time	Condition and Damage
October 30	22:45	Spillway of Los Laureles dam overflowed
October 30	22:00 – 23:00	Pescado Lake collapsed
October 30	22:00 – 24:00	Severe erosion and landslide occurred at El Country bridge
October 30 - 31	23:00 – 6:00	Outflow was at peak at Concepcion dam
October 30	24:00	Chiquito river was at peak
October 30 - 31	24:00 – 1:00	Landslide occurred in many locations
October 31	1:00	Flow at Chile Bridge was at peak
October 31	Morning	Landslide at Berinche occurred

Source : "Survey Response to Hurricane in Honduras in 1998" by USGS

The study on the flood analysis by the USGS is still on-going.

1.4.2 FLOOD SIMULATION BY ENEE

ENEE conducted a flood simulation during the Hurricane Mitch in Choluteca river basin in 1999. The study covered the area of about 1,800 km^2 in Choluteca river basin. An un-steady flow model was set up by using 1:10,000 and 1:50,000 topographic maps for river network. Calibration was done by using the water level during the Hurricane Mitch at Mallol and Prado bridge and other locations in the downstream as references. The results of the simulation can be summarized briefly as follows:

Table C.1.2 Results of Flood Simulation by ENEE

Basin	Area (km^2)	Flow (m^3/s)	Water Level (m)
Grande	259.5	620	954.45
Jacaleapa (San Jose)	173.0	366	954.45
Guacerique	236.4	565	928.60
Chiquito	236.4	565	925.10
Choluteca (after conflunce Chiquito)	-	1,795	927.30 (Mallol Bridge)
Choluteca downstream	1,761	3,795	-

Source : "Modelacion Hidrologica y Hidraulica Cuenca Alta del Rio Choluteca" by ENEE in 1999.

2. CHOLUTECA RIVER BASIN

2.1 RIVER CONDITION

Choluteca river originates from 3 main tributaries in the southern part of Tegucigalpa; Grande, San Jose and Guacerique rivers. The river takes its name after the confluence of these tributaries in Tegucigalpa.

The total drainage area is about 820 km^2 at Guanabarro as shown in *Figure C.1.1*, with the sub-basin areas as follows:

Table C.2.1 Drainage Basins of Choluteca River in Tegucigalpa

River/Basin	Basin Area (km^2)	
	Sub-basin	Total
Grande	258.18	258.18
San Jose	168.50	426.68
Guacerique	244.16	670.84
Chiquito	90.42	761.26
Sapo	2.97	764.23
Choluteca in Tegucigalpa	55.42	819.65

Source : Instituto de Geografico Nacional, 1/50,000

2.2 AVAILABLE DATA

2.2.1 RAINFALL

Rainfall data are available at the meteorological stations of SMN and SANAA in the basin as follows:

Table C.2.2 Rainfall Stations in the Choluteca River Basin in Tegucigalpa

Basin	Station	Recorded Data	
		years	Range
Grande	Concepcion	10	1990 - Present
	La Brea	15	1972 - 1986
	Lepaterique	30	1969 - Present
San Jose	Villa Real	10	1991 - Present
	El Aguacate	18	1973 - 1990
Guacerique	Batallon	38	1963 - Present
	Quiebra Montes	9	1992 - Present
Chiquito	Santa Lucia	15	1985 - Present
Tegucigalpa	Toncontin	50	1951 - Present

Source : SMN and SANAA

Rainfall data are recorded regularly 4 times a day at 6:00, 12:00, 18:00 and 24:00, daily rainfall is the summation of these recorded data.

The maximum, minimum and annual average rainfall are as follows:

Table C.2.3 Annual Rainfall in the Choluteca River Basin in Tegucigalpa

Basin	Station	Rainfall (mm/year)		
		Maximum	Minimum	Average
Grande	Concepcion	1,563	409	920
San Jose	Villa Real and El Aguacate	1,377	314	846
Guacerique	Batallon and Quiebra Montes	1,620	316	981
Chiquito	Santa Lucia	1,493	1,089	753
Tegucigalpa	Toncontin	1,274	453	866

Rainfall at Toncontin station was considered as the most reliable data for the entire basin because it had a long range of record and the hourly data during the Hurricane Mitch was available. Annual rainfall from this station is shown in *Table C.2.4.*

2.2.2 WATER LEVEL AND FLOW RATE

Data on water level and flow rate are available at the stream gauging stations of SANAA and SERNA in the basin as follows:

Table C.2.5 Stream Gauging Stations in the Choluteca River Basin in Tegucigalpa

Basin	Station	Type	Recorded Data	
			years	Range
Grande	Concepcion	Non-daily	14	1977 - Present
San Jose	El Incienso	Daily and Non-daily	16 7	1971 – 1986, 1993 - Present
	El Aguacate	Daily and Non-daily	29	1970 - Present
Guacerique	Batallon	Daily	10	1964 - 1973
	Quiebra Montes	Daily and Non-daily	11	1990 - Present
	Guacerique	Daily and Non-daily	19	1982 - Present
	Los Laureles	Daily	2	1999 - Present

Source : SANAA