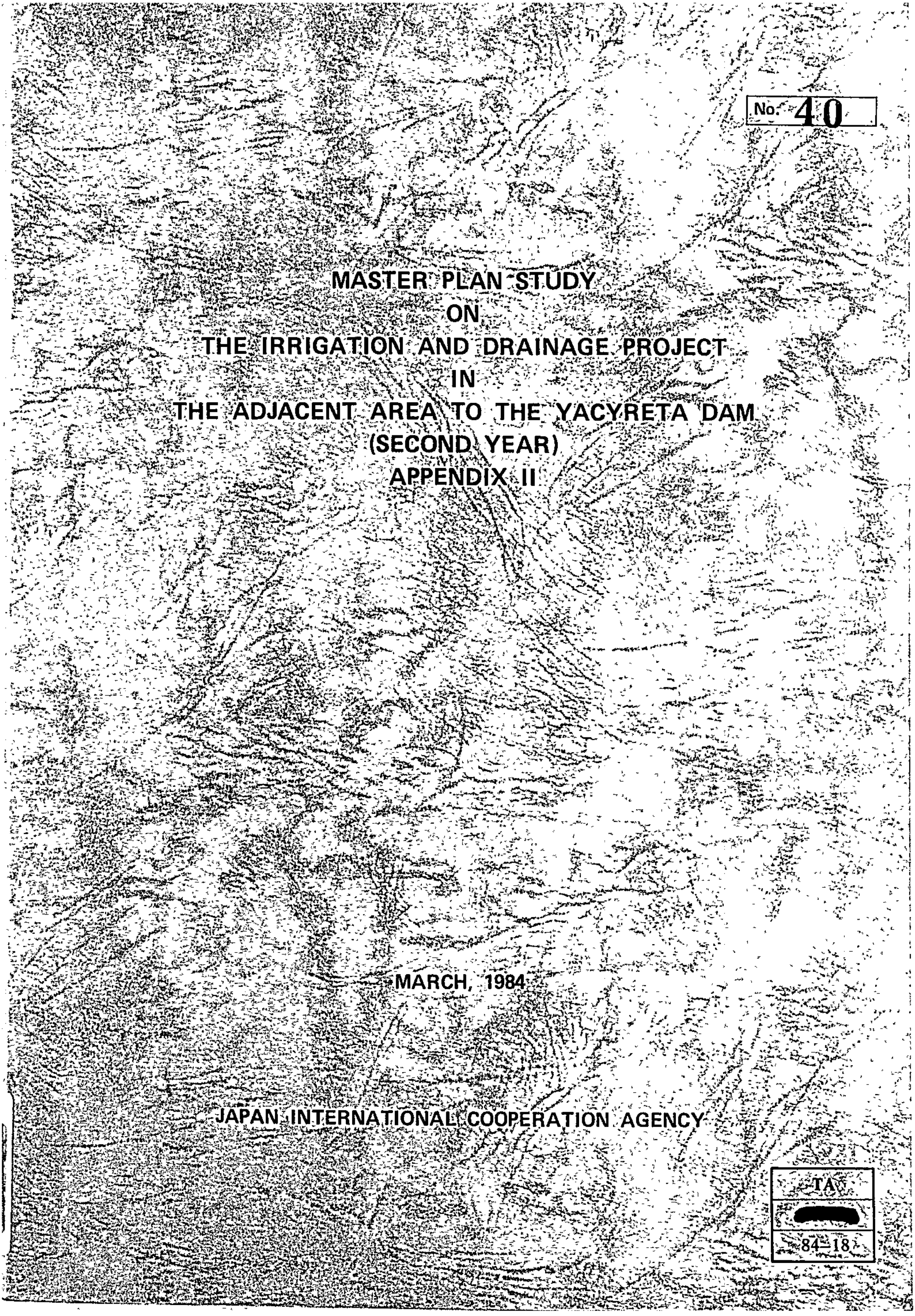

MASTER PLAN STUDY
ON
THE IRRIGATION AND DRAINAGE PROJECT
IN
THE ADJACENT AREA TO THE YACYRETA DAM
(SECOND YEAR)
APPENDIX II

MARCH, 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

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DRAINAGE PLAN

CONTENTS

5. RESULTS OF ANALYSIS

7. FIELD INVESTIGATION AND ANALYSIS IN THE THIRD YEAR

FIGURES AND TABLES

DRAINAGE PLAN

1. INTRODUCTION

The area of "The Irrigation and Drainage Project in the Adjacent area to the Yacyreta Dam", which has been investigated by the Agency, is a swampland with an area of about 150,000 ha located in the southeastern part of Paraguay. As shown in Fig. 1-1, the project area is surrounded by the Parana River on the south, the Yabebyry-San Ignacio Road on the west with the Neembucu Swamp beyond it, and a hilly region on the north and east with an elevation between 90 and 150 m, along the summit of which runs the national highway Route No. 1.

The runoff water of rainfall from the hilly region with an area of about 100,000 ha located to the north and east of the proposed area drains into the Parana River by way of the Atinguy and the Yabebyry Rivers. However, because the drainage capacity of these rivers is small and the area has many ups and downs with an overall inclination of about 1/1,000 from north to south, many places are left inundated with water. Part of water in the district drains to the Neembucu Swamp through the culvert constructed under the Yabebyry-San Ignacio Road to the west.

In this way, since rain water in the district and runoff water from the back land are not drained sufficiently due to the small drainage capacity of these rivers, the drainage improvement is essential for the new agricultural development. For this reason, the investigation and drainage analysis necessary for the drainage project in this district were performed and the size of facilities for the improvement of the drainage was determined.

In this report is mainly presented the drainage analysis based on the data obtained by the investigation performed in 1982 and the data necessary for the examination of the size of facilities for the drainage in this district.

The drainage analysis of the impounded condition was carried out by the use of the simulation method based on the numerical model which was developed by the Third Water Use Research Group of the Agricultural Engineering Research Institute, and the relationship between the facility size and the impounded condition was studied.

The distribution maps of designed rainfall and actual rainfall and the map of the drainage system were prepared from the investigation data for 1982 and the runoff analysis was performed by the use of various assumed values for the rainfall loss based on the data of investigations performed in the past in Japan. Items for which data should be collected by the field survey in future were also identified. The drainage facility size and the distribution of inundated areas were analyzed by carrying out the uniform flow analysis for the open channel, in which various types of drainage canals with different flow capacities were employed, and the general direction in preparing the outline of the drainage plan was shown.

2. PLANNING DIMENSION

1) Design Rainfall

(1) General description

The reference rainfall which would represent the project area should be determined so that it should become the basis for the calculation of the runoff amount in the proposed area.

Thus, the reference rainfall will be determined by the use of the data obtained at three stations operated by the Meteorological Department of the Ministry of Defense and at five stations operated by the Yacyreta Public Corporation, all in the vicinity of the proposed area as shown in Fig. 2-1.

However, since the observation periods of stations operated by the Yacyreta Public Corporation are short, lasting for only one or two years as shown in Table 2-1, the calculation of probability will be made by the use of the data collected at stations operated by the Meteorological Department of the Ministry of Defence, i.e., Encarnacion, San Juan Bautista, and Yacyreta. The rainfall distribution and correlations will also be obtained for the understanding of the rainfall characteristics and for the determination of the reference rainfall of the area.

(2) Rainfall records

All the rainfall records consist of daily rainfall. As shown in Table 2-1, the observation period is the longest at Encarnacion lasting for 40 years from 1940 to 1980 and San Juan Bautista is the next with records for 26 years from 1955 to 1980 and then, Yacyreta with the data lasting for 17 years from 1963 to 1980. All the other stations have the data for the period of only one or two years, since they started observation just recently.

(3) Calculation of probability rainfall by the Iwai-Kadoya method

The calculation of probability rainfall is necessary for the determination of the design rainfall. The following is the explanation of the probability rainfall calculated by the Iwai method.

Suppose there are N numbers of observed values X of rainfall arranged in the order of decreasing values.

X1, X2, X3, -----Xi, -----Xn, where the subscript i: the number of observations.

For the first approximation of the constant Xo, the following equation will be used and the geometric mean Xg of the rainfall will be obtained.

$$\log Xg = 1/N \cdot \sum_{i=1}^{n} \log Xi \ \ldots\ldots\ldots\ldots \ (1)$$

The constant b will be obtained by the following equation.

$$bi = \frac{Xi \cdot Xn - i + 1 - Xg^2}{2Xg - (Xi + Xn - i + 1)} \quad (i = 1.2, \ldots r) \ldots (2)$$

Now, r = N/10 (where r should be the integer after rounding to the nearest whole number). Then,

$$b = \frac{1}{r} \sum_{i=1}^{r} bi \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (3)$$

As can be understood from the equations (2) and (3), the constant b is derived from each successive pair of values at opposite ends of data arranged in the decreasing order and geometric mean Xo, and it should be the correction value at the zero point of the data.

Once b is obtained, the constant Xo will be derived by the following equation:

$$\log (Xo + b) = \frac{1}{N} \sum_{i=1}^{N} \log (Xi + b) \ \ldots\ldots\ldots \ (4)$$

The constant a will be obtained by substituting b and Xo in the following equation:

$$1/a = \frac{2}{N-1} \sum_{i=1}^{N} \left\{\log \frac{Xi + b}{Xo + b}\right\}^2 \ \ldots\ldots\ldots\ldots\ldots \ (5)$$

If the constants, a, b, and Xo, will be obtained, the exceeding probability rainfall Ru and the non-exceeding probability rainfall RL will be derived by the following equations:

$$\left.\begin{aligned}\log(R_u + b) &= \log(X_o + b) + \xi_u/a\\ \log(R_L + b) &= \log(X_o + b) - \xi_L/a\end{aligned}\right\} \quad \cdots\cdots\cdots(6)$$

Where ξ_u, ξ_L: normalized variables corresponding to the probability year T in Table 2-2.

Ideally, the equations (6) should be used for the infinite number of rainfall observations. However, since they are usually applied to the finite number of observations, they produce errors. For this reason, a modification has been made to the method by the use of the number of data and probability year, although the explanation of this modification will not be given here.

The annual maximum daily rainfall, two-day continuous rainfall and three-day continuous rainfall were analyzed for Encarnacion, San Juan Bautista and Yacyreta by the use of a computer and the results are shown in Table 2-3. According to the table, the ten-year probability rainfall, which is usually used for the domestic farmland drainage projects, is 164.4 mm/day for Yacyreta, 163.6 mm/day for Encarnacion, and 145.8 mm/day for San Juan Bautista. These values show that both Yacyreta and Encarnacion have a similar rainfall trend, while San Juan Bautista receives only 88.6% of the rainfall for Yacyreta, a station closest to the proposed district.

The ten-year probability rainfall for two-day continuous rainfall is 186.3 mm/2 days for Yacyreta, 203.9 mm/2 days for Encarnacion, and 194.7 mm/2 days for San Juan Bautista. The ratio of the probability rainfall for each station with respect to the one at Yacyreta is 1.09 for Encarnacion and 1.05 for San Juan Bautista. The ratio of the two-day continuous rainfall to the daily rainfall is 1.13 for Yacyreta, 1.25 for Encarnacion and 1.34 for San Juan Bautista. These facts show that the rainfall as heavy as the annual record at Yacyreta tends to be concentrated more in Yacyreta than in two other districts.

(4) Design rainfall

Although daily rainfall, two-day continuous rainfall, three-day continuous rainfall and others have been widely used in Japan for the reference rainfall, which is necessary for the preparation of the drainage plan, and hourly and four-hour rainfall for the peak drainage, the examination has to be made as to which rainfall is more appropriate for the reference rainfall and peak drainage in this district. The control area of each station has been decided by the Thiessen method in consideration of the rainfall distribution.

As shown in Fig. 2-2, the areal rainfall calculated by the Thiessen method using the rainfall data at three stations indicates that the entire proposed area is included in the control area of Yacyreta. Therefore, the reference rainfall will be decided by the use of the observation data at Yacyreta. Although a part of the drainage basin of the Yabebyry River is included in the control area of San Juan Bautista, the distribution of the areal rainfall indicates that the area may be included in the control area of Yacyreta probably because of the considerable distance of San Juan Bautista from the proposed area. If more data are collected by the rainfall observation now in progress at Santa Rosa, this conclusion could be reexamined.

The ratios of the ten-year probability daily rainfall of 164.4 mm to two-day continuous rainfall and to three-day continuous rainfall for Yacyreta are 1.13 and 1.24, respectively, showing that considerable amount of rainfall occurs as daily rainfall.

As the table for the frequency by different types of continuous rainfall (Table 2-4) shows, the frequency of rainfall of more than 5 mm/day in each event of continuous rainfall is 75% for daily rainfall, 16% for two-day continuous rainfall, 9% for rainfall continuous for three or more days, with the greatest frequency occuring as daily rainfall.

The drainage of this area has to be only of the gravity drainage type because of the economic reason. Besides, it is desirable to use, as the reference rainfall, the type of rainfall which would increase the peak discharge rather than the storage amount. This is because the drainage analysis will be performed in consideration of the propagation velocity of the flood so that the impounded water in the proposed area would become as small as possible. Thus, the reference rainfall for the drainage plan in the proposed area would be 1/10 probability daily rainfall of 164.4 mm/day for Yacyreta.

(5) Rainfall distribution

The hourly rainfall distribution is important for the hourly discharge analysis which is to be performed in the drainage analysis. However, since the hourly rainfall data are extremely scarce compared with the daily rainfall data, the former will be estimated from the latter.

Various estimation methods, including the Tarbott, Sherman, Ishiguro methods, have been used in Japan to obtain rainfall distribution. However, in the proposed area, we have not come up to the conclusion about which method to be used due to the scarce hourly rainfall data.

However, the actual amount of rainfall of 156.2 mm recorded on May 1, 1973 lasted for 12 hours and 10 minutes; it is known in the field that rainfall occurs at rather high intensity from the start of rainfall; and once rainfall occurs in 12 hours, its division equally to each hour is possible. Because of these reasons, the distribution of the reference rainfall in the proposed area was determined to be the 10-year probability daily rainfall of 164.4 mm equally divided by 12 hours.

(6) Rainfall characteristics

Since it is considered that rainfall changes with time and space and the proposed area includes mountains and plains with a total area of 250,000 ha, it is necessary to find out the distribution characteristics of rainfall.

Mean monthly rainfall from 1971 to 1980 is given in Table 2-5 and Fig. 2-3. This figure shows that July is the month with small amount of rainfall and that this situation lasts until around March of the following year. Then, the areal correlation of monthly rainfall was obtained by the use of the following formula, while the ratio of rainfall was examined for the understanding of the rainfall distribution.

$$y = \alpha \cdot x + \varepsilon \quad \dots\dots\dots\dots\dots\dots\dots\dots \quad (7)$$

where y, x: observed rainfall, α : partial regression coefficient, ε: error term.

If the value a estimated by the least square method is obtained for α by the use of the observed data, the estimated rainfall Y will be as follows:

affected by the Ita Ibate Dam located in the downstream side.

The confluence point of the Yabebyry and the Parana: 59.3 m, the confluence point of the Atinguy and the Parana: 65.5 m.

If the Parana River is to be incorporated into the model for the analysis of the present condition, the water level of 58.5 m at the location of the Ita Ibate Dam and the river discharge of $Q = 30,000\ m^3/sec$ from the upstream portion will be used.

$$Y = a \cdot x \quad \dots\dots\dots\dots \quad (8)$$

And the multiple correlation coefficient R will be as follows:

$$R = \frac{\sum_{t=1}^{n} (yt - \bar{y})\ (Yt - \bar{Y})}{\sum_{t=1}^{n} (yt - \bar{y})^2 \ \sum_{t=1}^{n} (Yt - \bar{Y})^2} \quad \dots\dots \quad (9)$$

The areal correlation calculated for each month by this equation is shown in Fig. 2-4, which indicates that the monthly rainfall for Encarnacion is about 10% higher than the one for Yacyreta. Fig. 2-5 shows the isohyets obtained by plotting the partial regression coefficient a. This figure tells that the district receives an almost equal amount of rainfall.

2) Design Water Level Outside the Project Area (Water level of the Parana River)

Since almost all the runoff water from the proposed area drains into the Parana River, the water level of the Parana River will be used as the water level outside the proposed area for the drainage analysis.

As shown in Fig. 1-1, the Yacyreta Public Corporation has plans for the construction of the Yacyreta Dam in the Parana River for the generation of electricity and for the procurement of water for the agricultural use and the Ita Ibate Dam for the transportation by ships. Therefore, the analysis of discharge conditions of the river has been performed.

The water level outside the proposed area will be examined by the use of the data obtained in the investigation conducted in 1982, since the detailed information about the operation of the dam gate and others is not available. The Figs. 2-6 through 2-9 show the data for the water level obtained in the 1982 investigation. The flood discharge Q of the Parana River of $Q = 30,000\ m^3/sec$ based on these figures and the following planned water levels for the outside region will be used for the drainage analysis with further assumption that the water level would be

3. ANALYSIS OF RUNOFF FROM RAINFALL

1) Analysis Method of Runoff from Rainfall

There are various methods suggested for the analysis of the rainfall runoff, although each of them has its own advantages and disadvantages.

In the proposed area the data for the rainfall runoff is scarce, although the hydrological analysis is required for the rainfall runoff. Therefore, the characteristic method was employed.

(Major analysis methods of runoff)

1. Paddy rice field runoff method
2. Combined characteristic method
3. Characteristic method
4. Storage function method
5. Runoff function method
6. Unit hydrograph method
7. Tank model method
8. Statistical unit hydrograph method

2) Analysis of Runoff from Rainfall Based on the Characteristic Method

(1) Analysis based on the characteristic method

If it is possible that the uniform flow approximation can be made for the flow on the slope by the use of the Manning equation as the equation of motion, then,

$$v = \frac{1}{N} \cdot R^{2/3} \cdot I^{1/2} \quad \cdots\cdots\cdots\cdots\cdots \quad (10)$$

$$Q = v \cdot A = \frac{1}{N} A \cdot R^{2/3} \cdot I^{1/2} \quad \cdots\cdots\cdots\cdots\cdots \quad (11)$$

The continuity equation will be:

$$\frac{\delta A}{\delta x} + \frac{\delta Q}{\delta x} = qx \quad \cdots\cdots\cdots\cdots\cdots \quad (12)$$

where v: mean velocity at the cross-section, h: water depth, I: gradient of slope, Ah: cross-sectional area of flow, n: Manning's roughness coefficient, Q: discharge, qx: lateral inflow.

The characteristic curve for the slope as shown in Fig. 3-1 by the use of the equations (11) and (12) will become:

$$\frac{\alpha x}{\alpha t} = \frac{5}{3} Q^{2/5} \left(\frac{I}{N}^{1/2}\right)^{3/5}$$

$$\frac{\alpha Q}{\alpha t} = qx \cdot \frac{\alpha Q}{\alpha X} + \frac{5}{3} qx \cdot Q^{2/5} \cdot \left(\frac{I}{N}^{1/2}\right)^{\frac{3}{5}} \qquad \ldots (13)$$

Next, the lateral inflow qx (in this case, rainfall) is generally solved more conveniently as a function of time. Therefore, from the equation (13),

$$Q = \left\{ K^{3/5} \int_2^t qx \cdot \alpha t \cdot Q2^{\frac{3}{5}} \right\}^{3/5} \ldots\ldots\ldots\ldots \quad (14)$$

where $K = \frac{I}{N}^{1/2}$.

Next, from the equation (13), the relationship between x and t will be

$$x = \int_2^t Cs \cdot \alpha x + X2 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (15)$$

where $Cs = \frac{5}{3} Q^{\frac{2}{5}} K$, $Q\tau$: discharge when $t = \tau$, $x2$: location when $t = \tau$. The above calculation will be made by the use of a computer.

(2) Runoff model

The drainage channels and rivers in the proposed area are mostly natural rivers and there are a few small-scale artificial canals which have not been systematically arranged. There would be various basic values from place to place for the slope angle and slope length for the calculation of discharge to the drainage rivers or to the main drainage canals in the proposed area by the characteristic method. It is also expected that the equivalent roughness coefficient would be different with different land use types, e.g., forest, grassland, paddy rice fields, etc. However, since the objective was to analyze the average runoff phenomena from the back land and from within the proposed area, a simple model was constructed.

I) Rainfall amount

One tenth probability daily rainfall of 164.4 mm for Yacyreta will be equally divided into 12 hourly rainfall (13.7 mm/hr).

II) Rainfall loss

Rainfall loss is the total rainfall minus direct runoff and is defined as:

$$\Sigma Rs = \Sigma R - \Sigma Q,$$

where Rs: rainfall loss, R: rainfall, Q: surface runoff.

The relationship between ΣR and ΣRs can be obtained if the observation data of rainfall and discharge are available. However, the discharge data for the proposed area have not yet been obtained by the past investigation, and therefore, the relationship between ΣR and ΣRs for the proposed area cannot be derived. The relationship between ΣR and ΣRs is available for Japan as shown in Fig. 3-2 and it is said that the rainfall loss approaches a constant value if the rainfall exceeds a certain value and that the constant value is about 50 mm for paddy rice fields.

Since the discharge observation data have not yet been available for Yacyreta, the effective hourly rainfall was determined by the following method on the assumption that rainfall loss is 0.0 mm, 50 mm, and 80 mm, respectively. The relationship between the rainfall loss (RL) and rainfall (R) can be expressed by the following equation:

$$RL = R\ (1.0 - aR^{b}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (16)$$

The constants a and b in the above equation (16) will be determined for the following conditions:

Assumed rainfall loss of 50 mm:

When $R = 0$, $RL = 0$;

When $R = 80$ mm, $RL = 50$ mm, $a = 2.5247 \times 10^{-4}$, $b = 5/3$.

Assumed rainfall loss of 80 mm:

When $R = 0$, $RL = 0$;

When $R = 120$ mm, $RL = 80$ mm, $a = 2.3148 \times 10^{-5}$, $b = 2.0$.

Therefore, the equation (16) will be:

When RL = 50 mm, $RL = R(1.0 - 2.5247 \times 10^{-4} \cdot R^{5/3})$ ...... (17)

When RL = 80 mm, $RL = R(1.0 - 2.3148 \times 10^{-5} \cdot R^{2.0})$ ...... (18)

Thus, Fig. 3-2 will be obtained.

The hourly effective rainfall obtained from equations (17) and (18) is shown in Table 3-1. In the present analysis, the discharge will be analyzed for the rainfall loss of 0.0 mm, 50 mm, and 80 mm, respectively, on the assumption that the same amount of rainfall loss can be applied to both the proposed area and the back land.

III) Base flow

The base flow is important for water use. However, in the flood season it is small in comparison with the peak discharge and, therefore, negligible. However, it has to be considered for the drainage analysis since the total amount of drainage water from runoff is important in the analysis. The base flow will be expressed in the daily mean discharge. In Japan, it is said to be about 1.0 $m^3/sec/100\ km^2$.

The base flow for the proposed area was determined as 0.0 in view of the situation that the discharge data for the area are not available and also that the water lost is based on the assumption. The interflow was also excluded because of the same reason.

IV) Length and gradient of slopes and rivers

The data were extracted from the 1/50,000 scale topographic map for the proposed area, and the numerical model was made, as shown in Fig. 3-3, by the use of the characteristic method for the back land with an elevation of over 80 m and by assuming that rivers and canals in the proposed area with an elevation of less than 80 m are channels and also by treating the drainage canal at the end of the drainage system and farmlands as the discharge unit as stated in 1). Even if streams are not specifically shown on the topographic map, indentations of contours so identified as valleys will be treated as streams.

V) Equivalent roughness

Since the equivalent roughness is the most important factor for the runoff analysis, it should be determined by the use of the discharge observation data. Based on the data available from other areas in the country, the roughness coefficients were determined as follows: $N = 0.5$ for slopes, and $N = 0.05$ for rivers and drainage canals on the assumption that they are natural rivers.

(3) Modeling of the hinterland

Based on the above conditions, the hinterland was divided into 30 blocks according to the topographic conditions and drainage systems as shown in Fig. 3-4. Various features of each block were determined from the topographic maps and shown in Table 3-2. They are illustrated in twelve groups in Figs. 3-5 and 3-6.

3) Results of the Analysis of Runoff from Rainfall

Table 3-3 shows the results of the runoff analysis based on the characteristic method. Peak discharge, time of peak discharge and specific peak discharge for each rainfall loss are listed in Table 3-4.

According to this table, the time lag between the start of rainfall and the peak discharge is 10 to 15 hours for the rainfall loss of 0.0 mm, 11 to 19 hours for the rainfall loss of 50 mm; and 12 to 24 hours for the rainfall loss of 80 mm. The specific peak discharge, when the rainfall loss is 0.0 mm, is 2.38 to 3.80 $m^3/sec/km^2$. All these values are graphically shown in Figs. 3-7 through 3-19.

4. ANALYSIS OF FLOW REGIME

1) Method for the Analysis of Flow Regime

The drainage systems in the proposed area consist of main rivers of the Atinguy and the Yabebyry, but other rivers, such as the Pikyry, the San Antonio, the Yacarey, the Tachicare, and others also flow into the area, thus presenting a constantly inundated condition without clear valley forms in various places at the center of the area. The reason for the inundated condition of the area would be that the drainage ability of the Atinguy and the Yabebyry is extremely small and even after the excavation of drainage canals a considerable amount of water seems to remain in the area. For this reason, a numerical simulation model, assuming the unsteady flow in rivers and drainage canals, will be used for the analysis.

2) Analysis of flow regime by the numerical simulation model

(1) Analysis method

I) Basic equations for the unsteady flow

The stream flow will be analyzed as the unsteady flow in the open channel. The equation of motion and the continuity equation for the open channel will be expressed as follows:

$$\frac{1}{g} \cdot \frac{\delta v}{\delta t} + \frac{1}{g} \cdot \frac{\delta}{\delta x} \left(\frac{v^2}{2}\right) + i + \frac{\delta h}{\delta x} \frac{n^2 |v|}{h^{4/3}} v = 0 \ldots (19)$$

$$\frac{\delta A}{\delta t} + \frac{\delta Q}{\delta x} - q = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (20)$$

where g: gravitational acceleration (9.8 m/sec^2), v: mean cross-sectional velocity, Q: discharge across the cross-sectional area, h: water depth, A: cross-sectional area of flow, q: lateral inflow into the stream (per unit length), i: gradient of river bed, i + $\delta h / \delta x$: gradient of water surface.

II) Difference equations of basic equations

The basic equations (19) and (20) will be expressed by the difference equations and they will be integrated for the given topographic and inflow conditions. Here, the central differences which have comparatively high accuracy for their ease of handling were used for the distance x and time t. The subscript i shows the distance difference and the subscript j the time difference. With the central difference of (i, j-1), the unknown value for (i, j) will be obtained from the initial condition and the boundary condition.

a) Difference equation of the equation of motion

The central difference of each term in the equation (19) will be expressed as follows:

$$
\begin{aligned}
\frac{\delta v}{\delta t} &= \frac{v_{i,j} - v_{i,j-2}}{\Delta t} \\
\frac{\delta h}{\delta x} &= \frac{h_{i,j} - h_{i,j-2}}{\Delta x} \\
\frac{\delta v^2}{\delta x} &= \frac{v_{i+2,j-2}^2 - v_{i-2,j-2}^2}{2:\Delta x} \\
i &= \frac{Z_{i+1} - Z_{i-1}}{\Delta x} \\
h &= \frac{h_{i+1,j-1} + h_{i-1,j-1}}{2} \\
v &= \frac{v_{i,j} + V_{i,j-2}}{2}
\end{aligned}
\qquad \cdots\cdots\cdots\cdots\cdots \text{(21)}
$$

where z: height of the river bed from the reference level, as shown at grid points (Fig. 4-1-c).

b) Difference equation of the continuity equation

The differentiation of each term in equation (20) will be performed, in which case the following procedure will be taken to increase the accuracy of the continuity condition with regard to the irregular-shaped stream channels.

b-1) Cross-sectional area A of flow

The cross-sectional area A of flow is generally expressed by the function of water depth h. The relationship between these two variables can be approximated with a straight line in a full log graph paper and the equation of the line is expressed by the following:

$$Ai = ai \cdot hi \cdot mi \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (22)$$

A river with high and low beds has a composite cross-section of a broken line which is expressed by two equations. As shown in Fig. 4-1-a, the water depth is obtained for points of even numbers of distance difference. Therefore, the subscript i in the equation (21) will become even numbers and constants ai and mi will also be located at points of even numbers.

b-2) δA/δt term

$$\delta A/\delta t = \frac{\delta A}{\delta h} \cdot \frac{\delta h}{\delta t} = (\text{channel width}) \times \frac{\delta h}{\delta t} \quad \ldots\ldots \quad (23)$$

The channel width for the above equation should be the mean width of the stored water in the distance Δx. It is at points 1, 2, and 3 in Fig. 4-2 that the cross-section of the stream flow A is given as a topographic condition in the form of the equation (22). On the other hand, the distance for which the continuity equation is applied is the cross-section Δx for 1 to m cross-sections.

Then, the channel width W for the cross-sections ℓ and m will be averaged for the points 1, 2, and 3, as follows:

$$Wi = \frac{\delta Ai}{\delta hi} = ai \cdot mi \cdot hi^{mi-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (24)$$

$$i = 1, 2, 3$$

Therefore,

$$W\ell = \frac{W1 + W2}{2}, \quad Wm = \frac{W2 + W3}{2} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (25)$$

Thus, the storage area As for the distance between ℓ and m is:

$$As = (3W_2 + \frac{W1 + W3}{2}) \times \frac{\Delta x}{4} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (26)$$

Then, the mean channel width W for the storage area between ℓ and m is:

$$W = \frac{\delta As}{\delta x} = \frac{1}{4} (3W_2 + \frac{W1 + W3}{2}) \quad \ldots\ldots\ldots\ldots \quad (27)$$

The substitution of (27) into (23) will give:

$$\delta A/\delta t = \frac{1}{4} (3W_2 + \frac{W1 + W3}{2}) (\frac{hi,j - hi,j-2}{\Delta t}) \ldots\ldots \quad (28)$$

b-3) δQ/δx term

In Fig. 4-2, the cross-sectional area of flow for m cross-section = (A2 + A3) and the cross-sectional area of flow for ℓ cross-section = (A1 + A2). Since the velocities of water which flows through the cross-sections m and ℓ have already been obtained from the equation of motion: the discharge through the cross-section m = (A2 + A3)/Vm, and the discharge through the cross-section ℓ = (A1 + A2)/Vℓ.

Therefore,

$$\delta Q/\delta x = \left(\frac{A2 + A3}{2} Vm \quad \frac{A1 + A2}{2} V\ell \right)/\Delta x \; \ldots\ldots\ldots \quad (29)$$

b-4) q term

The inflow at points which are not affected by the flow regime of the main river is taken care of by this term. For all the other points this term will be set to be 0. The difference equation of the continuity equation was expressed by grid points as shown in Fig. 4-1-b.

III) Boundary conditions

The boundary conditions are given in either one of the two variables, i.e. , the discharge or the water level. The discharge will be used if a pump, etc. are used at boundary points in rivers, canals, etc. and the water level will be used if the discharge observation is difficult. If the boundary condition for the upstream and downstream ends is given by the discharge, the q term in the equation (20) will be used.

a) In case the open sea is downstream and the non-tidal point is upstream

The left portion of Fig. 4-3 shows how the boundary on the downstream side is given. j = 1, 2 is given as the initial condition. The water depth (water level) for (i = 2, i = 3) is given independently by the tidal oscillation of the open sea.

The water depth at (4, 3) can be obtained by the continuity equation, letting the origin of a triangle as the unknown. The same numerical method will be used to find the water depth in the i direction (x direction). The upstream boundary is shown in the right portion of Fig. 4-3, where i = d is the upstream end. The water depth at (d, 3) will be obtained by substituting the hydrograph of the inflow for the q term in the continuity equation (20).

The same value is given to the water depth at both (f, 3) and (d, 3) and the section between b and f is considered to be horizontal. Next, the equation of motion will be used to obtain the velocity for the point after the advancement of the distance Δx/2, from the previous point. In this case, the zero value will be given for the boundary condition at (1, 4) whenever the velocity of flow becomes zero immediately after the entry of water into the open sea. Otherwise, the same velocity as one for (3, 4), which will be handled next, will be used. On the other hand, in the upstream side, the velocity of flow at point (e, 4) will always be set at 0. The water depth and velocity at j = 3, 4, obtained by the above method, will be transferred to j = 1, 2 and the water depth and velocity for the next point will be obtained by the same procedure as stated above.

b) In case there is only the change in water level in the upstream and downstream sides

If only the water depth is given, with the inflow left unknown, for the boundary condition, the following procedure will be taken: at the downstream end, the change in water depth will be given, as a boundary condition, to i = 2, the continuity equation will be solved for i = 3 or greater, leaving the velocity at i = 1 and i = 3 equal, while at the upstream end, i = d will be set as the last, to which the change in water depth will be given as a boundary condition. Thus, the continuity equation will be solved up to i = b.

Then, the equation of motion will be solved up to i = c and the value at i = c will be given to the velocity point at i = e. By giving the boundary condition in this way and only by the use of the change of water depth on the upstream and downstream sides, the flow regime in a section can be analyzed as an unsteady flow phenomenon.

(2) Steps of calculation

The basic equations (19) and (20) will expressed in the difference equations, which will, then, be integrated for Δt under the given condition. A certain value of water level will be established as the initial value for the points of even numbers, which are m = 1 in Fig. 4-4, and the initial value of velocity will be applied to the points of odd numbers of i, which are n = 2 with an advancement of $\Delta x/2$ from the even numbers. Then, the water level and velocity for n = 3, 4 will be calculated based on these values. The solution will be obtained by the repetition of this calculation in the Δx direction and Δt direction. The operation grid interval of Δx and Δt must satisfy the following relationship for the stability of the answer.

$$\Delta t < \left| \frac{\Delta x}{V\text{max} \pm \sqrt{g \cdot h\ \text{max}}} \right| \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots \quad (30)$$

(3) Initial conditions

In case the initial storage in the channel is negligible because of the comparatively flat hydrograph of the inflow at the beginning of the operation, the use of the mean water depth and the velocity of zero for all the points of water depth would not cause any problem. For the use of the water level as the boundary condition, the water level between points should be obtained by the linear proportional allotment, leaving the velocity also as zero. The effect of the initial condition quickly disappears as soon as the operation is started and the flow regime which satisfies the operation condition will show up.

(4) Calculation for the point of intersection

In case there is a lateral flow which is subjected to the effect of the water surface in the operation grid, the calculation for the point of intersection will be carried out. The water level, velocity and discharge will be calculated first for each interval under the boundary and initial conditions. Then, the calculation will be continued by applying the water level in the downstream side of the channel to the initial water level in the upstream side of the same channel.

(5) Calculation of the inundated condition

The inundated condition within the proposed area occurs when the water level in the channel increases above the embankment or the present foundation. In such a case, it is assumed that the change in water level has occurred in the entire area of the proposed area and it is regarded that the water is stored in the inundated area. It is also assumed that the water is collected to the channel when the water level decreases, provided, however, that the calculation of the channel will be performed for the shaded area in Fig. 4-5.

3) Modeling of the proposed area

(1) Establishment of the calculation condition

As for the present drainage condition of the proposed area, drainage channels have not been well organized. Besides, the rivers from the surrounding mountain areas flow into the swamp land, without developing definite river forms. Therefore, drainage systems will not be clearly identified in the present condition and the analysis under such a condition does not make much sense for the preparation of the drainage plan. Presently, the construction of the Yacyreta Dam and the Ita Ibate Dam has been planned in the Parana River.

Therefore, in this report, the analysis for the present condition was omitted, but models were made for the following 8 cases and the runoff amount corresponding to the respective rainfall loss conditions of 0.0 mm, 50 mm and 80 mm, were combined with each of the following 2 systems and the total number of 24 cases were analyzed. These case numbers are shown in Table 4-1.

(System I)

As given in Fig. 4-7, it is intended to discharge the water from the area and from the hinterland mostly from the north to the south, by adding 2 of main drainage canals besides existing the Atinguy River and the Yabebyry River.

The model view of the drainage system is given in Fig. 4-9.

(System II)

As given in Fig. 4-8, it is intended to discharge most of the rainfall from the hinterland and the project area into existing the Atinguy River and the Yabebyry River, in which relatively large amount of rainfall is to flow from the east to the west.

The model view of the drainage system is given in Fig. 4-10 and 4-11.

(2) Determination of Δx and Δt

The accuracy in the numerical model simulation can be increased by the adoption of the smaller interval of Δx and Δt. However, it also means the increased amount of calculation requiring a large amount of time and labor for the analysis even with the use of the computer. Therefore, the modeling will be necessary.

If a small value of Δx, as applied to other areas of the country, is used for the huge proposed area as large as 150,000 ha, an enormous number of grid squares will be needed. Also in consideration of the accuracy, etc. of the data for landforms, drainage canals, etc. and the past accuracy of the calculation, it was concluded that the number of grid squares should be limited as small as 300 at the stage of the preparation of the master plan and the number should be tested by various models for the preparation of data for a better plan. Thus, the following values were adopted here: Δx = 1,500 m and Δt = 60 seconds. For the same reason, the terminal and branch drainage canals were not incorporated into the model but were given as the lateral inflow data.

(3) Elevation data of rivers and canals

For the determination of the cross-sectional data of rivers and canals, the results of the field survey are usually used. However, since the objective of the present analysis is to obtain data necessary for the preparation of the master plan, the elevation of rivers and farmlands will be read directly from the 1/50,000 scale topographic maps and the elevation of the canal base and the river beds will be determined by subtracting the water depth from the elevation.

(4) Cross-sectional shape

The cross-sectional shape will be approximated by the composite trapezoid as shown in Fig. 4-6, provided, however, that a model will be made by regarding the cross-sections in system II through 4 as the simple trapezoid for the ease of calculation. Since the drainage canals attached to the Yacyreta Dam have already been designed for all cases of System II in the Halza Report, the data will be used.

(5) Roughness coefficient

Although it is advisable to determine the roughness coefficient from the discharge observation data, etc. in the field, the following values taken from other places were used in the present analysis since the appropriate data are not available in the field: rivers without improvement work: 0.05, rivers with improvement work and drainage canals: 0.04.

(6) Lateral inflow

a) The runoff calculated from the characteristic method will be used as an input for the lateral inflow. The same assumptions for rainfall, etc. as explained in the section on the characteristic method will be used here.

b) Runoff from farmland

Since the land use plan has not yet been determined for the proposed area, the runoff obtained by the characteristic curve method multiplied by the control area of each grid square will be used as the lateral inflow on the assumption that the entire control area of rivers and drainage canals incorporated into the model is under the same condition.

c) Water level outside the proposed area

The water level outside the proposed area, which corresponds to the planned water level of 30,000 m^3/sec for the Ita Ibate Dam, will be applied to the Ita Ibate Dam site in the system II-1 and to the confluence of the Parana River in another cases.

(7) Illustration map of the drainage system

A map of the drainage system was constructed and is shown in Fig. 4-7 and 4-8. The illustration maps of the drainage system were made from this figure for system I (Fig. 4-9) and for system II (Fig. 4-10 and 4-11).

(8) Numerical model

The data on the cross-section used in the numerical simulation model for the drainage analysis of the proposed area are shown in Table 4-2. The explanation of variables is given in Fig. 4-6.

5. RESULTS OF ANALYSIS

1) Water Levels of Rivers and Drainage Canals

The amount and location of impounded water and the period of the inundated condition have to be analyzed for the construction of the drainage plan. It is, therefore, very important to know the behavior of the water level of rivers and drainage canals. For this purpose, the water level within the channel which was obtained by the numerical simulation was rearranged and shown in Figs. 5-1 through 5-66.

The explanation of these figures will be made in the text for the system II of the rainfall loss of 50 mm. For cases in which the rainfall loss is 0.0 mm and 80 mm, please refer to the figures and tables which are similar to the ones used in the explanation of the case of rainfall loss of 50 mm.

(1) The Yabebyry River drainage system

According to system II-1 (Fig. 5-44), the water level in the grid square number 8 (No. 7 in system II-1 through II-4), which is the location to which the Yabebyry River flows out, made a rapid increase at the rate of 0.22 m/hr in the period between 5 hours and 14 hours after the start of rainfall, reaching the peak water level of 61.5 m at 16 hours, and showed a gradual decrease until 30 hours, when the water level slowly started to increase again, reaching the 61.3 m level at 69 hours, then gradually lowering to the level of 61.24 m at 120 hours.

The two peaks in the water level at this location seem to have occurred due to the difference in the arrival time between the upstream discharge and the one in the vicinity. And, the reason why the second peak is not clear is that the runoff of water stored in the upstream portion occurred and that even at this location the inundated condition persisted with water above the level of the paddy field of 61.0 m.

According to the system II-2, the water level increases at the rate of 0.21 m/hr in the period between around 5 hours and 18 hours after the start of rainfall and stays nearly constant until around 32 hours. Then, the water level drops remarkably until around 50 hours when the decrease in water level slowed down. In this case, too, the inundated condition with the maximum at about 0.8 m was found from about 14 hours until around 37 hours.

In system II-3, the water level increased rapidly at the rate of about 0.12 m/hr from around 5 hours after the start of rainfall, reaching the peak water level of 61.02 m at 24 hours and then quickly started to drop until around 50 hours when the quick drop was replaced by the gradual one. In system II-3, the inundated condition at the flowout point disappeared and a clear peak of the water level showed up, indicating the decreased amount of flowout from the stored water in the upstream portion.

In system II-4, the water level showed a gradual increase at the rate of about 0.02 m/hr from around 5 hours to 21 hours after the start of rainfall. After reaching the peak water level of 60.40 m, the water level gradually decreased.

A comparison of peak water levels in systems II-1, II-3, and II-4, using the peak water level in system II-2 as the reference level, shows that all three systems have lower values than the reference level as follows: system II-1: -0.44 m, system II-3: -0.78 m, system II-4: -1.40 m.

According to Fig. 5-47, the water level at No. 26 (No. 19 in systems II-2 through II-4), which is the middle course of the Yabebyry River, is as follows: in system II-1, the water level increases at the rate of 0.1 m/hr from 4 hours to around 25 hours after the start of rainfall and the gradual increase in water level continues thereafter until it reaches the peak water level of 70.94 m at 56 hours. Then, the level gradually decreases. This is because the area is inundated from around 18 hours until after 120 hours without showing a clear peak.

In system II-2, the water level increases rapidly at the rate of approximately 0.27 m/hr from around 7 hours to about 16 hours, reaching the peak water level of 68.68 m at 23 hours at the level shows little change until 29 hours. Then, it drops quickly until around 45 hours when the water level started to take a gradual decrease. It seems that this trend is because of the certain amount of flowout of stored water in the upstream portion.

System II-3 and system II-4 show a similar change in water level, with the peak water level of 67.73 m at 17 hours in system II-3 and 67.06 m at 18 hours in system II-4.

A comparison of peak water levels in systems II-1, II-3, and II-4 with the one in system II-2 shows that the difference in water level was +2.26 m, -0.95 m and -1.26 m, respectively.

Next, the water level at point No. 76 which has a large amount of runoff water from the back land will be discussed.

According to Fig. 5-53, the water level in system II-1 reaches the peak water level of 71.64 m at 38 hours after the start of rainfall, gradually decreasing thereafter. The area is inundated from around 6 hours until after 120 hours after the start of rainfall.

In system II-2, the water level increases rapidly at the rate of 0.5 m/hr from around 4 hours until around 10 hours after the start of rainfall, reaching the peak water level of 70.94 m at 23 hours and then drops quickly. The area is inundated with water from 6 hours to around 35 hours.

System II-3 and System II-4 show almost the same change in water level, with the peak water level at 70.07 m in system II-3, and 69.37 m in system II-4.

(2) The Atinguy River drainage system

The water level of the Atinguy River, which drains water from the western part of the proposed area, was examined.

According to Fig. 5-56, the change in water level at No. 168, which is the location to which the water flows out from the proposed area, is as follows:

In system II-1, the water level increases rapidly at the rate of 0.2 m/hr from around 5 hours until around 18 hours after the start of rainfall, reaching the peak water level of 67.82 m at 26 hours and shows a gradual decrease thereafter. Then, from around 50 hours until around 70 hours the water level drops rather rapidly at the rate of about 0.05 m/hr and stays nearly constant at the level of about 66.3 m.

This is because the water, once stored in the upstream inundated area, flows out gradually.

In system II-2, the water level increases rapidly at the rate of 0.2 m/hr from around 5 hours until around 14 hours after the start of rainfall, reaches the peak water level of 68.05 m at 25 hours, and decreases abruptly from around 30 hours until around 60 hours, which is replaced by the gradual decrease thereafter. This seems to have occurred by the decreased peak discharge by the stored water in the upstream inundated area.

In system II-3, the water level increases linearly to the peak water level of 67.37 m from around 10 hours to 18 hours, decreases sharply toward around 50 hours and then decreases gradually.

In system II-4, a change in water level similar to the one in system II-3 is observed, with the peak water level of 66.75 m at 17 hours. This seems to mean that in both systems II-3 and II-4, the effect of the upstream inundation is negligible. A comparison in peak water levels for systems II-1, II-3, and II-4 with the one in system II-2 shows that the difference in water level is -0.23 m, -0.10 m and -1.31 m, respectively.

Judging from the drainage system, etc., these values seem to be reasonable.

The examination of water level at No. 174, which is located in the middle course of the Atinguy River, indicates, as shown in Fig. 5-59, that in system II-1 the water level increases rapidly at the rate of 0.17 m/hr up to 16 hours after the start of rainfall, reaching the peak water level of 72.86 m at 33 hours and gradually decreases thereafter until 30 hours, then changing to the rapid decrease until 45 hours.

The water levels in system II-3 and system II-4 show the similar trend, with the peak water level at 70.76 m at 16 hours in system II-3 and 70.05 m at 15 hours in system II-4.

A comparison in peak water levels between the system II-2 and the other systems shows a rapid decrease in water level, with +1.13 m in system II-1, -0.97 m in system II-3 and -1.68 m in system II-4.

The peak water level and its occurrence time were rearranged as shown in Table 5-2 and 5-3, which also shows that the greater is the cross-section of flow and the smaller is the rainfall loss, the earlier the peak water level appears.

2) Discharge of Rivers and Drainage Canals

It is important to know the behavior of discharge in rivers and drainage canals for the examination of the drainage plan. Since the poor drainage in the proposed area in particular seems to have been largely caused by the small drainage capacity of the drainage rivers in the area, i.e., the Yabebyry River and the Atinguy River, the emphasis will be placed on these two rivers in the analysis. The discharge data obtained by the numerical simulation were rearranged and shown in graphs in Figs. 5-67 through 5-114, and the peak discharge, its occurrence time and the specific peak discharge for rivers and drainage canals were rearranged in Table 5-5 and 5-6.

According to Fig. 5-110, the discharge at No. 8 (No. 7 for systems II-2 through II-4), which is the location to which water flows out from the drainage basin of the Yabebyry River, is as follows: in system II-1, the discharge reaches its peak at 15 hours after the start of rainfall and decreases until 30 hours thereafter. It gradually increases again until it reaches the peak discharge of 209.0 m^3/sec at 69 hours. Then, the nearly constant discharge is maintained until after 120 hours. The reason why two peaks appeared is that the peak discharge of rainfall from the vicinity occurred first and then came the propagation of the peak discharge from the upstream portion. The reason for the indistinct second peak discharge may be that the peak discharge exceeding the drainage capacity of the river occurred on the upstream side, thus causing the impounded condition on the upstream side, which, in turn, led to the moderated peak discharge.

In system II-2, the discharge increases almost linearly from after 5 hours until 20 hours after the start of rainfall and reaches the peak discharge of 1,282 m^3/sec at 22 hours. Then, the discharge maintains a nearly constant value until 40 hours, dropping sharply thereafter. Starting at around 50 hours it changes to a gradual decrease. The gradual change in discharge is due to the inundation.

The discharge in system II-3 and system II-4 shows a similar tendency, with sharp increase in discharge from about 5 hours to about 18 hours, reaching the peak discharge of 1,787 m^3/sec at 20 hours in system II-3 and 1,778 m^3/sec at 21 hours in system II-4. The discharge rapidly decreases thereafter until 50 hours and then takes a gradual decrease.

The change in discharge at No. 168 which is the location to which water flows out from the drainage area of the Atinguy River lows:

According to Fig. 5-113, the discharge in system II-1 increases until around 20 hours after the start of rainfall; then, maintains a constant value of 200 m^3/sec until around 50 hours. The discharge gradually decreases thereafter, reaching a stable level of around 58 m^3/sec at around 75 hours.

In system II-2, the discharge increases rapidly from around 7 hours until 15 hours, reaching the peak discharge of 750 m^3/sec at 16 hours and gradually decreases until around 30 hours. Then, the discharge quickly drops until 45 hours, when it changes to a gradual decrease.

The change in discharge in system II-3 and system II-4 follows a similar trend, showing a sharp increase from around 9 hours with the peak discharge of 1,105 m^3/sec in system II-3 and 1,132 m^3/sec in system II-4 both at 17 hours. It drops sharply after around 45 hours, changing to a gradual decrease since then. This change in discharge seems reasonable in view of the drainage system.

According to Table 5-5 and 5-6, the peak discharge appears roughly in the period between 14 hours and 24 hours after the start of rainfall. However, if the rainfall loss is great, a lag time of 1 to 3 hours occurs. If there is an effect of inundation, the peak discharge will be delayed considerably.

The peak discharge for each system and for each point was obtained as shown in Table 5-6 for comparison. According to the table, at point No. 8 with rainfall loss of 50 mm, the peak discharge for system II-1 was 0.339 m^3/sec/km^2, 1.129 m^3/sec/km^2 for system II-2, 1.664 m^3/sec/km^2 for system II-3, and 1.339 m^3/sec/km^2 for system II-4 and at point No. 168 with rainfall loss of 50 mm, the peak discharge was 0.302 m^3/sec/km^2 for system II-1, 1.129 m^3/sec/km^2 for system II- , 1.664 m^3/sec/km^2 for system II- and 1.704 m^3/sec/km^2 for system II-4. The relationship between these peak discharge values and the cross-sectional areas is shown in Figs. 5-115 through 5-118.

According to Fig. 5-117, at point No. 8 of the Yabebyry River with the rainfall loss of 0.0 mm, the specific peak discharge increases more or less with the increasing cross-sectional area up to 2.0 m^3/sec/km^2. However, if the cross-sectional area exceeds 2.0 m^3/sec/km^2, the increasing rate of these factors diminishes. For the rainfall loss of 50 mm, the specific peak discharge becomes 1.0 m^3/sec/km^2 for the cross-sectional area of 1.0 m^3/sec/km^2, while, for a cross-sectional area of 2.0 m^3/sec/km^2 is 1.35 m^3/sec/km^2, which is equal to 67% of the ability of the cross-section of the uniform flow, and for a cross-sectional area of 3.0 m^3/sec/km^2 it is 1.34 m^3/sec/km^2, which is equal to 45% of the ability of the cross-section of the uniform flow.

For the rainfall loss of 80 mm, the specific discharge is 0.87 m^3/sec/km^2 which is 87% of the capacity for the cross-section of 1.0 m^3/sec/km^2, and about 0.92 m^3/sec/km^2 for the cross-sections of both 2.0 m^3/sec/km^2 and 3.0 m^3/sec/km^2, without indicating any significant change in the specific peak discharge with the increasing cross-sectional area. The specific discharge for the point No. 168 in the Atinguy River as shown in Fig. 5-118 also indicates the tendency similar to the one for the point No. 8.

3) Distribution of the Inundated Area

For the understanding of conditions of disasters caused by the inundation, it is important, in the preparation stage of a drainage plan, to analyze the location and the amount of impounded water. Therefore, the distribution of the inundated area will be obtained from the result of the drainage simulation and the maximum depth for each case will be shown graphically in Figs. 5-119 through 5-130 and 5-152 through 5-163. Also, the temporal change of the distribution of the inundated area, for systems I-1, I-2, I-3, I-4, II-1, II-2 and II-3, when the rainfall loss is 50 mm will be shown for every 10 hours in Figs. 5-131 through 5-151 and 5-164 through 5-163.

Please note, in reading these figures, that the symbol for the grid square showing the maximum depth of inundation was applied to the entire grid. The distribution of the maximum depth of inundation for system II-1 with the rainfall loss of 50 mm is given in Fig. 5-156, which shows

that the entire area is inundated. This can be further seen in a series of time span in Figs. 5-164 through 5-170. According to these figures, the inundation has already started in considerable areas at H = 10 and in particular it is clear that the inundation has started from the upstream side. The reason for the inundation in the vicinity of the points No. 43 and No. 106 in the central part of the proposed area is that these locations are liable to be inundated due to the depressed condition. At H = 20, the inundated area extended more and more toward the downstream direction. At H = 30, the upstream side showed a gradual decrease in the inundated condition, while in the middle course portion, on the contrary, the inundated condition was intensified. At H = 40 the same trend continued. At H = 60, the inundated condition disappeared in the eastern side of the proposed area, while in the Yabebyry River the inundated area also appeared in the downstream portion. Meanwhile, in the depressed area at the central portion of the proposed area no change is recognizable any.
A similar trend was seen at H = 80 and 100. This means that in system II-1 a marked inundated condition exceeding the water depth of 1 m occurs for a long time due to the small cross-sectional area of the flowing water in both the Yabebyry and the Atinguy. According to Fig. 5-157 for system II-2, there is not much change in the geographical distribution of the inundated area. However, the number of grid squares with less than 1.0 m of water depth increased. As shown in Figs. 5-171 through 5-174, for the temporal change of the distribution, the inundation at the depth of 30 to 50 cm has already started in the upstream side at H = 10. Since the impounded area at the depth of greater than 50 cm increases at H = 20, showing nearly the same distribution as the one for the maximum inundation in system II-2, it seems that somewhere around H = 20 is the time for the peak of inundation. Fig. 5-171 also shows that the inundation started near the location to which water flows out from the drainage area of the Yabebyry River, and that the peak water level is propagated to the downstream side. At H =30, the inundated area disappears except for the depressed area at the center of the proposed area. However, inundated areas, probably attributable to the

landform condition, are left at places. At H = 40, the inundated condition almost disappears. This may mean that in system II-2, the water, although impounded, does not stay long and the time of inundation is less than approximately 20 hours.

According to Fig. 5-158, the number of grid squares showing inundation is mainly 10 to 30 cm in system II-3. In the same way, the temporal distribution of the inundated area is shown in Figs. 5-175 through 5-177. At H = 10 the grid squares showing inundation are scattered and the depth of inundation is mainly 10 to 30 cm. At H = 20, the similar distribution is seen. At H=30, almost all inundated areas disappears. This means that in system II-3 the inundation is not caused by the small drainage capacity of rivers but by the local topographic condition and also that the period of inundation is mainly around 10 hours or less.

In system II-4, as shown in Fig. 5-159, the inundated areas are all local, which are probably caused by the local topographic condition and not by the small drainage capacity of the river.

The area of inundation and the percentage of the inundated area are shown in Tables 5-8 through 5-13. They are also shown regionally in Table 5-6. According to Table 5-12, with rainfall loss of 50 mm, the percentage of the inundated area with more than 5 cm in water depth is 21.75% for system II-1, 10.25% for system II-2, 2.55% for system II-3 and 1.25% for system II-4, indicating the tendency that the percentage of the inundated area decreases with the increasing cross-sectional area. The relationship between the size of the cross-sectional area of drainage canals and the percentage of the inundated area is shown in Figs. 5-178 through 5-179 which were based on Tables 5-8 through 5-13.

According to Figs. 5-178 through 5-179, the decreasing trend in the percentage of the inundated area slows down with the increasing size of the cross-sectional area. For the rainfall loss of 0.0 mm the cross-sectional area is not so large. However, for the rainfall loss of 50 mm and 80 mm, the cross-sectional area becomes 50% greater than the original size, but the percentage of the inundated area decreased by only 1.3% for the rainfall loss of 50 mm, and 0.3% for the rainfall loss of 80 mm. This fact may have to be considered for the determination of the cross-sectional area of drainage canals in future.

6. CONCLUSION

The results of the analysis so far presented are summarized as follows:

1) The planned reference rainfall for the drainage plan should be the 1/10 probability daily rainfall of 164.0 mm at Yacyreta Station.

2) The runoff of rainfall from the back land, estimated by the characteristic method, is characterized as follows: if the rainfall loss is 0.0 m/m, the peak runoff occurs at around 10 to 15 hours after the start of rainfall and the specific peak discharge is roughly 2.5 m^3/sec/km^2 to 3.8 m^3/sec/km^2 ; if the rainfall loss is 50 mm, these values are 11 to 19 hours and 1.3 to 3.6 m^3/sec/km^2, respectively; if the rainfall loss is 80 mm, 12 to 24 hours and 0.8 to 2.8 m^3/sec/km^2.

3) The cross-section of the present flow at locations to which water flows out from the drainage basins of the Yabebyry and the Atinguy is roughly 0.2 to 0.35 m^3/sec/km^2 in the specific peak discharge. In order for the inundated area with water depth of over 5 cm to be kept in less than about 10% in the proposed area, the cross-section of roughly 1.75 m^3/sec/km^2 is necessary for the rainfall loss of 0.0 mm, 1.0 m^3/sec/km^2 for the rainfall loss of 50 mm, and 0.7 m^3/sec/km^2 for the rainfall loss of 80 mm.

4) The study on the specific peak discharge at the location to which water flows out from the drainage basins of the Yabebyry and the Atinguy River shows that the specific discharge does not increase very much even with the cross-section of 2.0 m^3/sec/km^2 for the rainfall loss of 0.0 mm and 50 mm or with the cross-section of more than 1.0 m^3 /sec/ km^2 for the rainfall loss of 80 mm. Therefore, the reason should be examined in determining the size of the cross-section of rivers.

5) For the rainfall loss of 50 mm, if the present river is used, many places will be left in the inundated condition with the depth of water of 2.0 m and the inundation period of more than 80 hours. However, for the cross-section of 1.0 m^3 the inundation period will be about 20 hours except for some places; for the cross-section of 2.0 m^3 the inundation

period will be approximately 10 hours; and for a cross-section of 3.0 m^3, there will be little inundation.

6) According to the relationship between the percentage of the inundated area and the cross-section of drainage canals and rivers, the percentage of the inundated area decreases only a little even if the cross-section of greater than 2.0 m^3/sec/km^2 is used for the rainfall loss of 0.0 mm and 50 mm, or the cross-section of greater than 1.0 m^3/sec/km^2 for the cross-section of 80 mm. Therefore, it is necessary to examine the project effect in determining the size of a drainage project.

7) There are several depressions within the proposed area. In order to drain water from these places, a canal as deep as roughly 5 m will be needed. However, since this is not economical, methods of drainage from these areas should be considered in the examination of the land use plan.

7. FIELD INVESTIGATION AND ANALYSIS IN THE THIRD YEAR

Since the analysis presented in this report is based on the results of the field investigation performed mainly in the 1982 and 1983 fiscal year, it is necessary to collect new data required for the drainage analysis in the field investigation to be performed in future. The methods of collecting and rearranging data are shown below:

1) Rainfall Data

Since the planned district is rather large with an area of about 150,000 ha, it is necessary to understand the rainfall characteristics within the proposed area and its vicinity. The daily rainfall data collected by stations established recently by the Yacyreta Public Corporation in the surrounding areas of the proposed area and the daily rainfall data at long-term weather stations which correspond to the stations established by the Yacyreta Public Corporation will be obtained and used, together with the already collected data, for the calculation of the areal correlation of rainfall. The hourly rainfall data for heavy rainfall will also be collected for the drainage analysis.

2) River Discharge

In preparing the drainage plan, the runoff from the back land and from within the proposed area must be determined by observing the river discharge. For the estimation of the discharge of a river, the water level must be observed by installing a staff gauge; it must also be observed at locations where the Q-H curve as obtained elsewhere can be constructed. However, where the drainage raises problems, the Q-H curve will not be constructed but only the water level observation will be made. In such a case, any shortcoming caused by the absence of the curve can be evaded by measuring the water level at more than two locations at the same time.

The observation method of the river discharge will be explained below:

(1) Q-H curve

The Q-H curve of a river will be constructed by observing the discharge. The observation of discharge will be made by the method shown elsewhere.

The construction of the Q-H curve, based on the discharge observation, is rather difficult because the wide range of discharge data has to be collected. Therefore, two methods will be explained here for the construction of the Q-H curve, i.e., the method using the numerical model and the one by repeated observations of discharge.

The lonitudinal profile of a river is shown in Fig. 5-1. If this profile is divided into sections of x in width and incorporated into a numerical model, the drainage system will show up as in Fig. 5-44. If the cross-sectional shape of a river is given as data into the numerical model and the river discharge is obtained for different values of the roughness coefficient n of the river, the Q-H curve can be made as shown in Fig. 5-45. On the other hand, if the observed values of discharge and water depth are plotted on this Q-H curve, the roughness coefficient of a river can be obtained. Meanwhile, the Q-H curve can also be made by the use of the limited number of the discharge observation data.

For rivers whose water level is affected by the water level in the downstream portion, the Q-H curve, based on the parametarization of the water level in the downstream portion as shown in Fig. 5-46, will give the discharge of the river by the observation of the water level at two locations.

(2) Water level observation

It is desirable to observe discharge of a river at as many locations as possible since the factor is important for the drainage analysis. However, the observation has to be made so that the best result could be attained with the least budget and labor. It is, therefore, necessary to make an observation in the proposed area at three locations, i.e., the point to which water flows out from the mountains, the point at which water flows into the Parana River, and the middle point of the proposed area.

The locations of observation points are shown in Fig. 5-47. In the middle portion of the figure shows observation points of the water level in the swamp. Since the location of observation points shown in the figure may have to be moved depending on the physical conditions of the observation points, it is advisable to decide the location after performing the field survey.

(1), (2) : discharge observation in the drainage rivers

(3), (4) : observation of water level and depth of impounded water in the proposed area

(5), (6) : observation of runoff from mountains

3) Inundated Condition

It is efficient to study the distribution of the depth of inundation at the time of heavy rain, since the plains are often inundated like swamps. If the distribution of inundation is shown on a map based on such a study, it may be effectively used for the comparison with the result of the analysis.

4) Runoff from Rainfall

The amount of runoff from rainfall must be analyzed in preparing the drainage plan. The rainfall and river discharge data will be used for the analysis of the following terms:

(1) Effective rainfall (rainfall loss)

(2) Base flow

(3) Intermediate runoff

(4) Surface runoff.

The methods to obtain these factors will not be explained here since they were described already in the section on the analysis of runoff from rainfall.

FIGURES AND TABLES

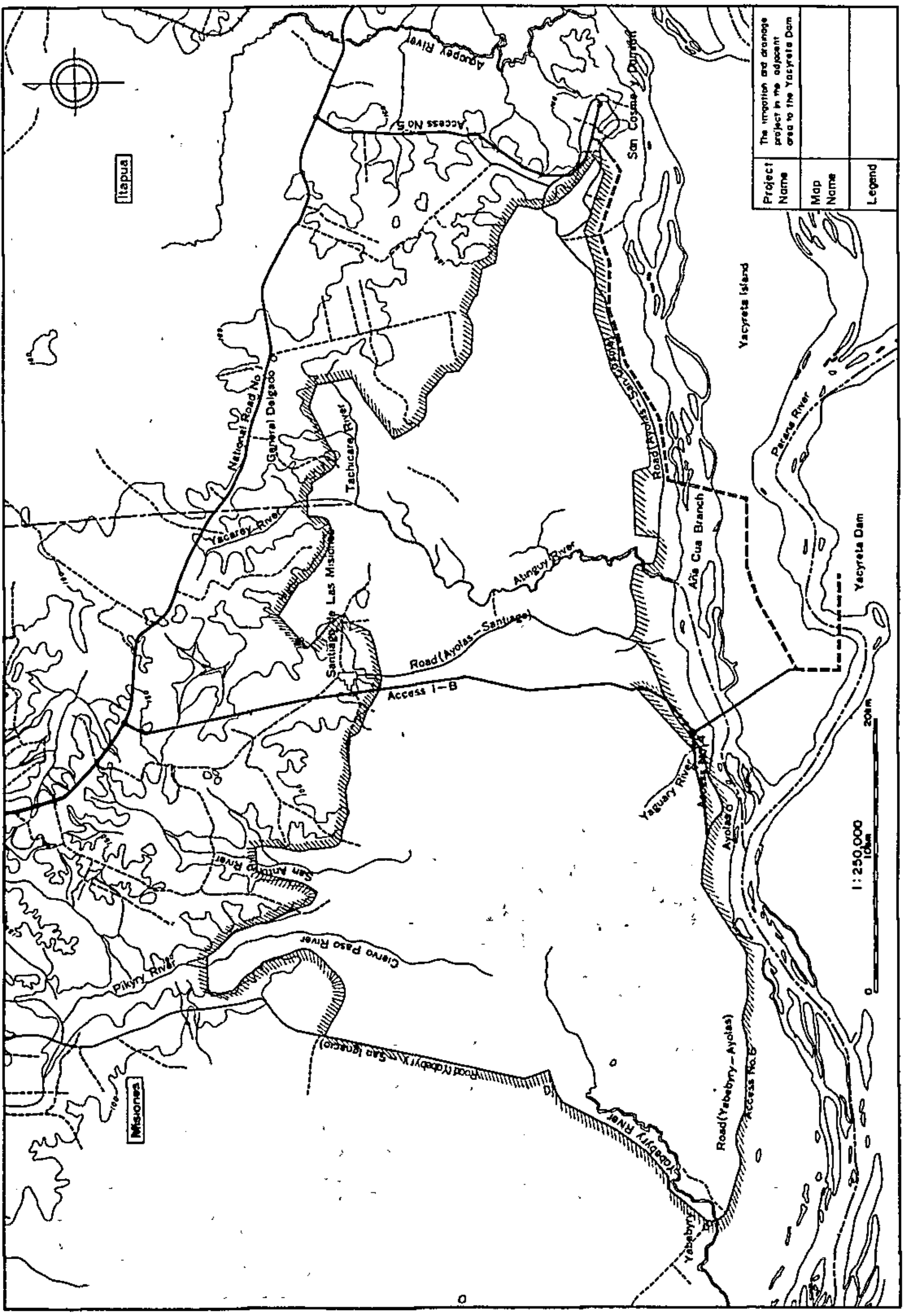


Fig. 1-1 General Planning Map

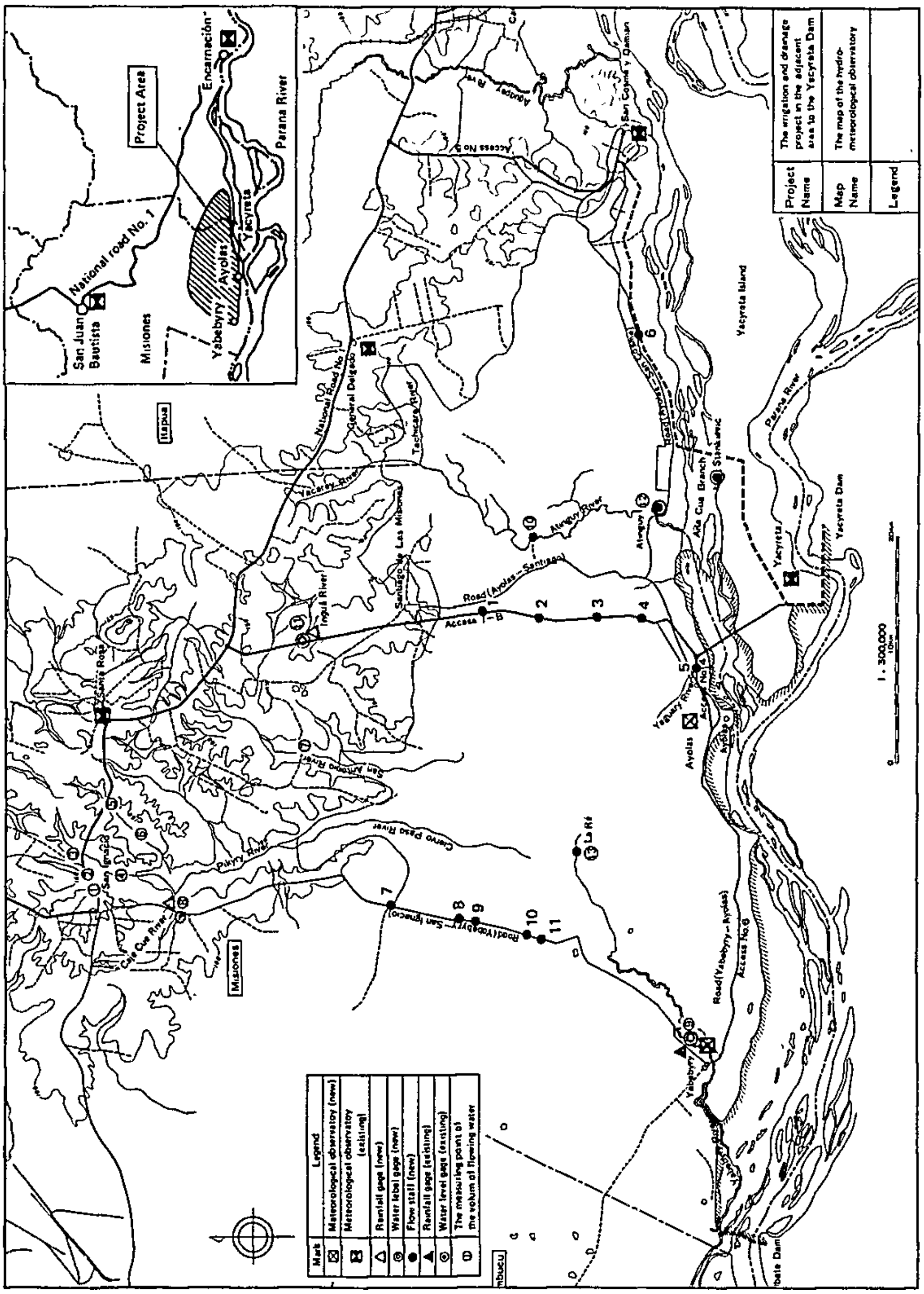


Fig. 2-1. Location of Meteorological Observation Stations

Table 2-1 List of Observation Instruments in Meteorological Observation Stations

Observation station	Position		Attached facility	Collected data	Period of data collection	Notes
Encarnacion	Lat. S Lon. W Elev.	27°19'45" 57°50'55" 91.6 m	National Bureau of Meteorology	Atmospheric pressure, temperature, humidity, wind direction, wind velocity, amount of evaporation, rainfall, daily amount of sunlight	1940. 1∿1980.12	No data for Jan. ∿ Feb., 1940
San Juan Bautista	Lat. S Lon. W Elev.	26°40'12" 57°09'06" 125.7 m	"	"	1955. 7∿1980.12	
Yacyreta	Lat. S Lon. W Elev.	27°24'00" 56°27'00" 86.0 m		Atmospheric pressure, temperature, humidity, wind direction, wind velocity, rainfall	1963. 3∿1980.12	No data for Jul. ∿ Dec., 1964, Dec., 1967
Santa Rosa	Lat. S Lon. E	26°53'15" 56°50'55"	Yacyreta Corporation	Temperature, humidity, rainfall	1981. 6∿1982. 7	
Gral Delgado	Lat. S Lon. E	27°07'05" 56°23'52"	"	"	"	
Carmen del Parana	Lat. S Lon. E	27°13'38" 56°05'30"	"	"	"	
San Cosme y Damián	Lat. S Lon. E	26°18'59" 56°19'44"	"	"	"	
Ayolas	Lat. S Lon. E	27°23'27" 56°48'22"	"	"	"	

Table 2-2 Probability Normalized Variables

τ	$1/\tau$	ξ
500	0.00200	2.0352
400	0.00250	1.9840
300	0.00333	1.9227
250	0.00400	1.8753
200	0.00500	1.8214
150	0.00667	1.7499
100	0.01000	1.6450
80	0.01250	1.5851
60	0.01667	1.5049
50	0.02000	1.4522
40	0.02500	1.2859
30	0.03333	1.2971
25	0.04000	1.2379
20	0.05000	1.1631
15	0.06667	1.0614
10	0.10000	0.9062
8	0.12500	0.8134
5	0.20000	0.5951
4	0.25000	0.4769
3	0.33333	0.3045

Table 2-3 Probability Rainfall Based on the Iwai-Kadoya Method

(Unit: m/m)

Proba-bility year	Yacyreta			Encarnacion			San Juan Bautista		
	Daily rainfall	Two-day continuous rainfall	Three-day continuous rainfall	Daily rainfall	Two-day continuous rainfall	Three-day continuous rainfall	Daily rainfall	Two-day continuous rainfall	Three-day continuous rainfall
100	231.3	241.5	252.3	239.0	289.2	371.3	187.4	271.0	289.9
80	224.8	236.7	248.3	231.5	281.0	358.3	183.7	263.9	283.1
50	211.3	226.2	239.7	215.9	263.7	331.0	175.8	248.7	268.7
40	204.8	221.0	235.4	208.5	255.5	318.3	171.9	241.4	261.7
30	196.6	214.3	229.6	199.2	245.0	302.2	166.9	232.0	252.7
20	184.8	204.4	221.0	186.0	229.9	279.5	159.4	218.5	239.5
15	176.4	197.1	214.5	176.7	219.2	263.6	153.9	208.7	229.9
10	164.4	186.3	204.6	163.6	203.9	241.2	145.8	194.7	215.8
5	143.0	165.9	185.0	141.0	176.6	202.8	130.4	169.2	189.8
3	125.9	148.1	166.8	123.4	154.7	173.4	117.0	148.4	167.8

Observation year: Yacyreta 1965 ∿ 1980
Encarnacion 1940 ∿ 1978
San Juan Bautista 1956 ∿ 1980 (except 1974)

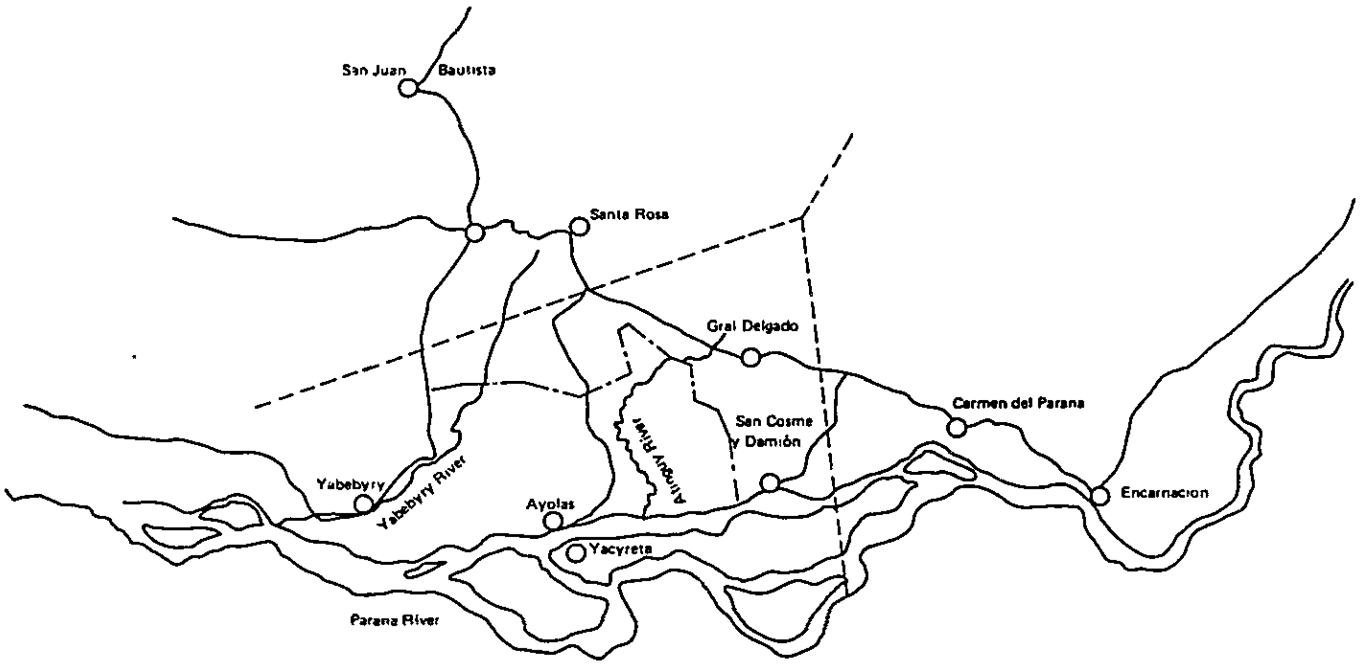


Fig. 2-2 Division of the District by the Thiessen Method

Table 2-4 Frequency of Continuous Rainfall Days

Yacyreta 5 m/m or more daily rainfall

Year of observation \ Amount of rainfall \ No. of continuous rainfall days	1-Day			2-Day			3-Day or more			Notes
	∿ 50 m/m	50∿100 m/m	100 m/m ∿	∿ 50 m/m	50∿100 m/m	100 m/m ∿	∿ 50 m/m	50 ∿ 100 m/m	100 m/m ∿	
1965	29	10	-	2	1	-	1	-	2	
1966	22	3	2	3	1	-	1	1	4	
1967	24	2		6	3	-	1	-	-	
1968	27	6	-	1	-	-	1	3	-	
1969	28	3	2	3	1	-	-	1	1	
1970	21	6	-	5	6	1	1	-	-	
1971	27	3	1	4	1	1	-	1	-	
1972	23	3	-	6	2	-	1	2	4	
1973	25	4	1	11	2	1	1	3	2	
1974	29	5	-	5	1	-	-	1	1	
1975	39	2	-	2	-	1	-	2	1	
1976	28	3	-	1	2	-	1	2	1	
1977	23	3	-	7	2	-	1	1	1	
1978	22	1	-	8	-	2	1	1	1	
1979	31	3	-	3	4	-	-	2	2	
1980	19	5	-	3	2	-	1	3	2	
Total	417	49	6	70	28	6	11	23	22	632
Average	26.1	3.1	0.4	4.4	1.8	0.4	0.7	1.4	1.4	39.5
Proportion	0.66	0.08	0.01	0.11	0.04	0.01	0.02	0.04	0.03	
For No. of continuous days	0.75			0.16			0.09			

Table 2-5 Monthly Rainfall and Days of Rainfall (Average)

(Units: m/m, days)

Observation station	Item	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Yearly
Encarnacion	Amount of rainfall	156.1	137.6	150.7	118.8	144.6	136.5	95.4	125.3	141.4	178.9	140.2	170.1	1,695.6
	Days with rain	9	7	8	7	7	8	8	8	7	9	9	8	95
San Juan Bautista	Amount of rainfall	189.5	108.7	164.9	121.4	122.4	109.6	79.4	108.1	91.9	198.9	188.8	160.8	1,644.4
	Days with rain	10	7	8	7	7	7	6	7	6	9	8	7	89
Yacyreta	Amount of rainfall	130.8	130.5	131.7	121.7	124.3	129.4	90.5	108.9	107.9	164.0	140.2	135.7	1,515.6
	Days of rainfall	8	6	7	6	6	7	7	7	5	8	8	7	82

Source: National Bureau of Meteorology

Statistical period: 1971 ~ 1980

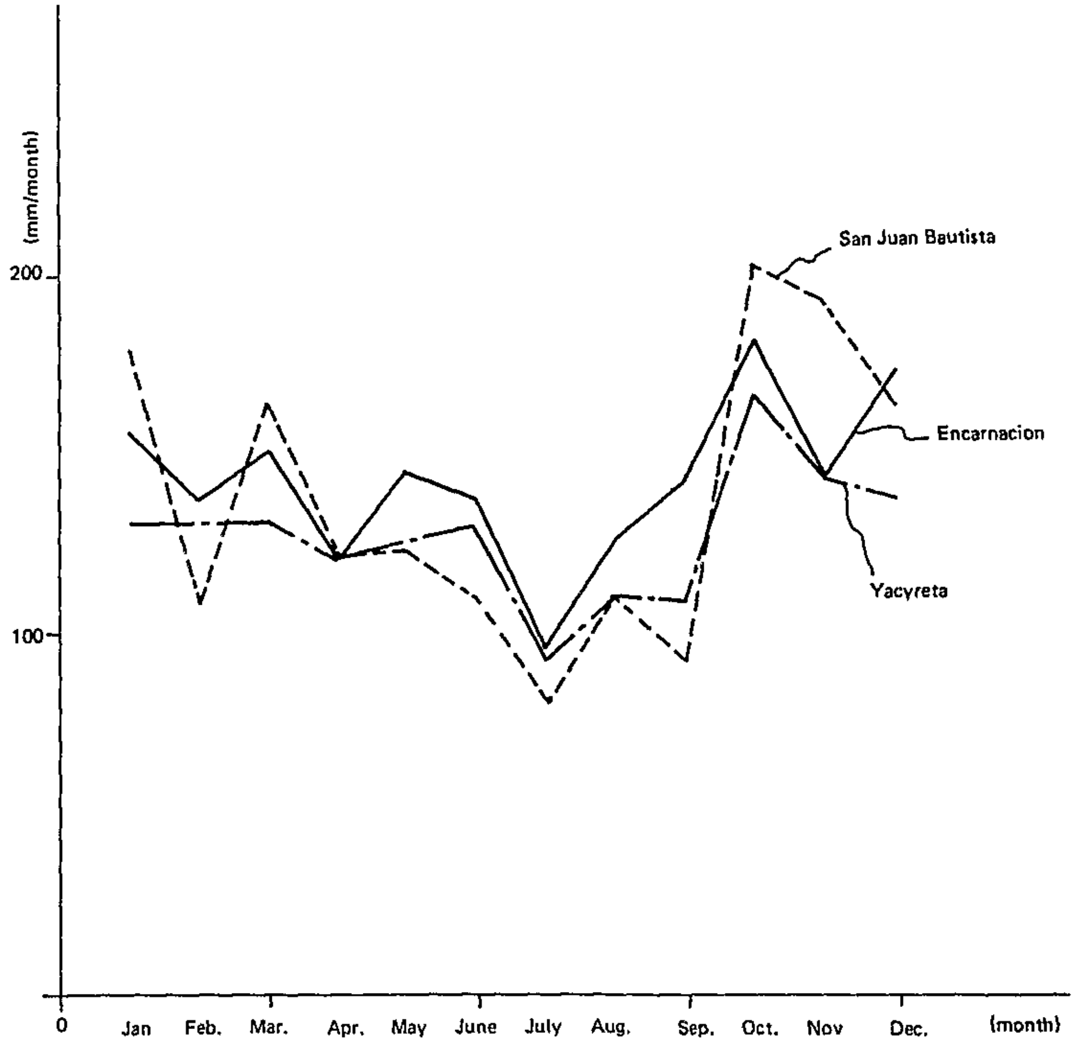


Fig. 2-3 Monthly Mean Rainfall

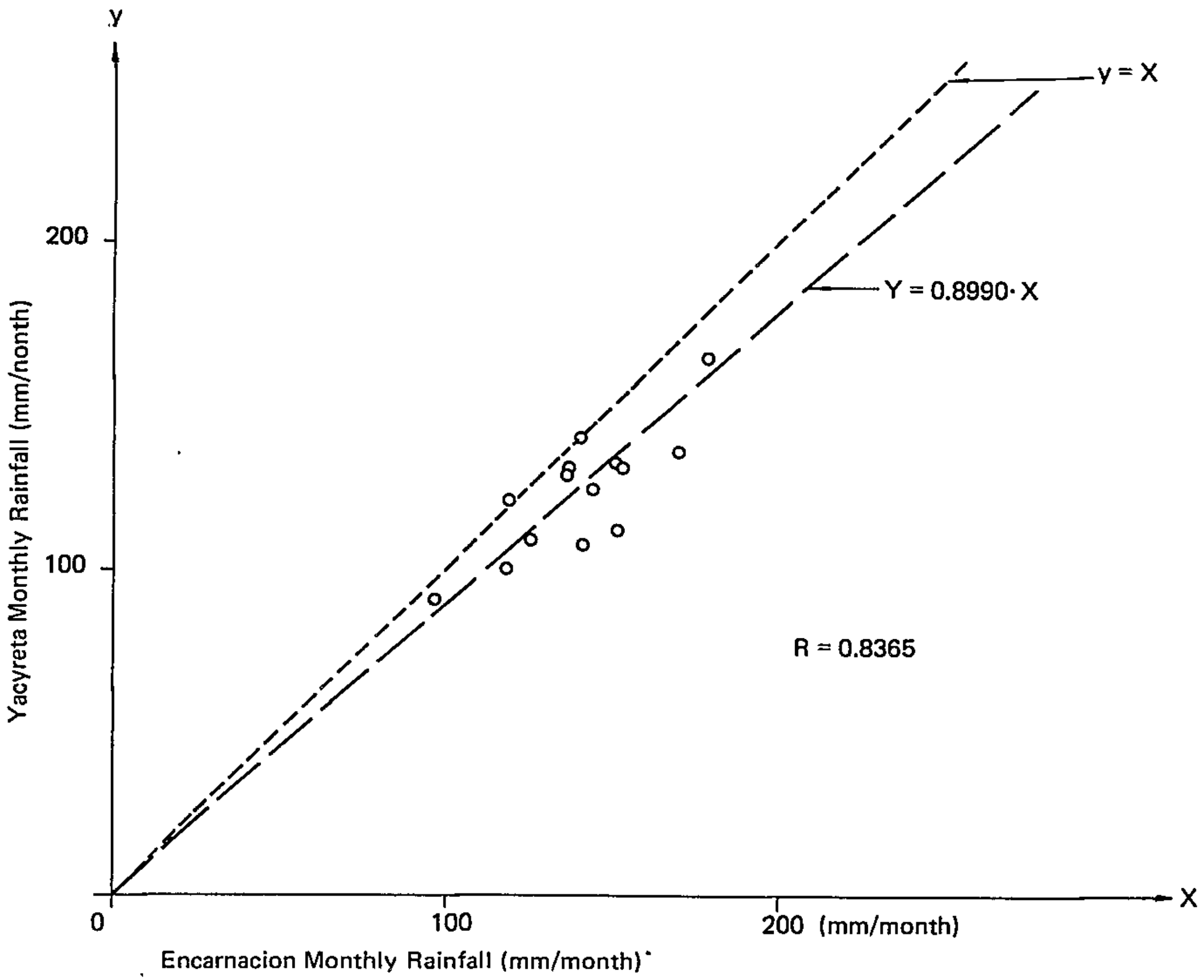


Fig. 2-4 Areal Correlation of Monthly Mean Rainfall (1971 ~ 1980 average rainfall)

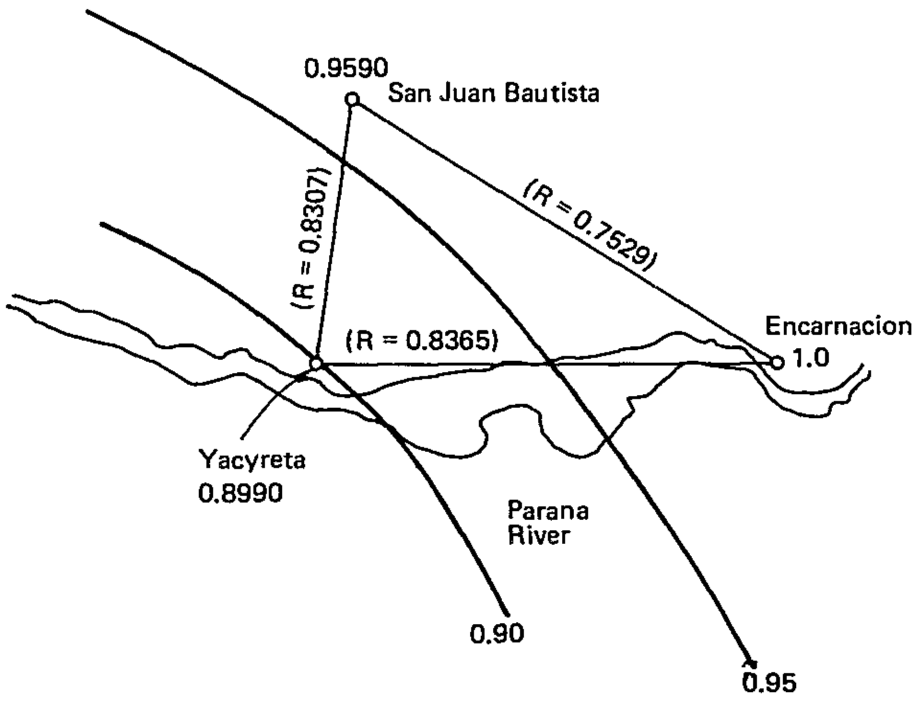


Fig. 2-5 Intensity Line and Areal Correlation of Monthly Mean Rainfall

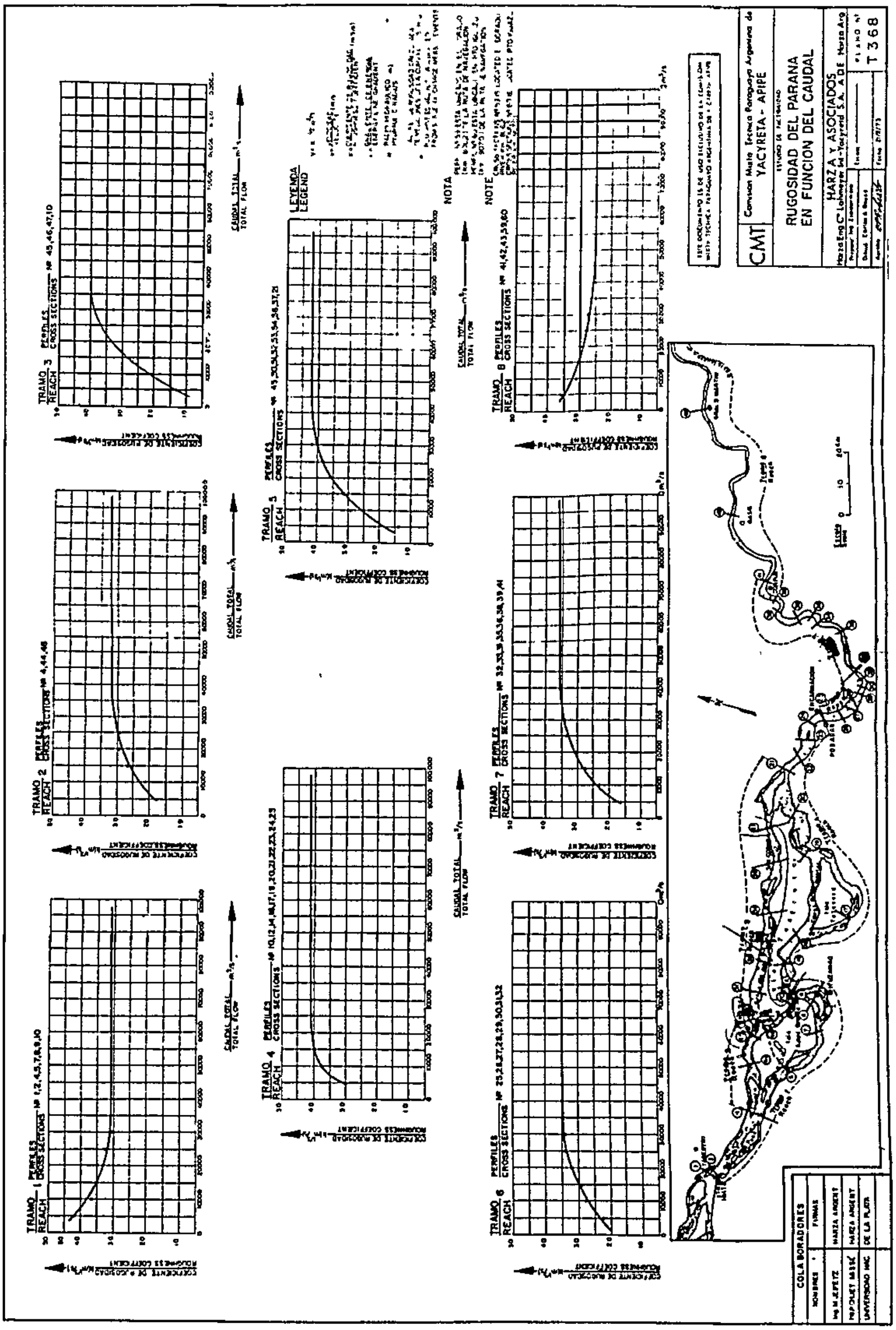


Fig. 2-6 Water Level Data for the Yacyreta Dam Project

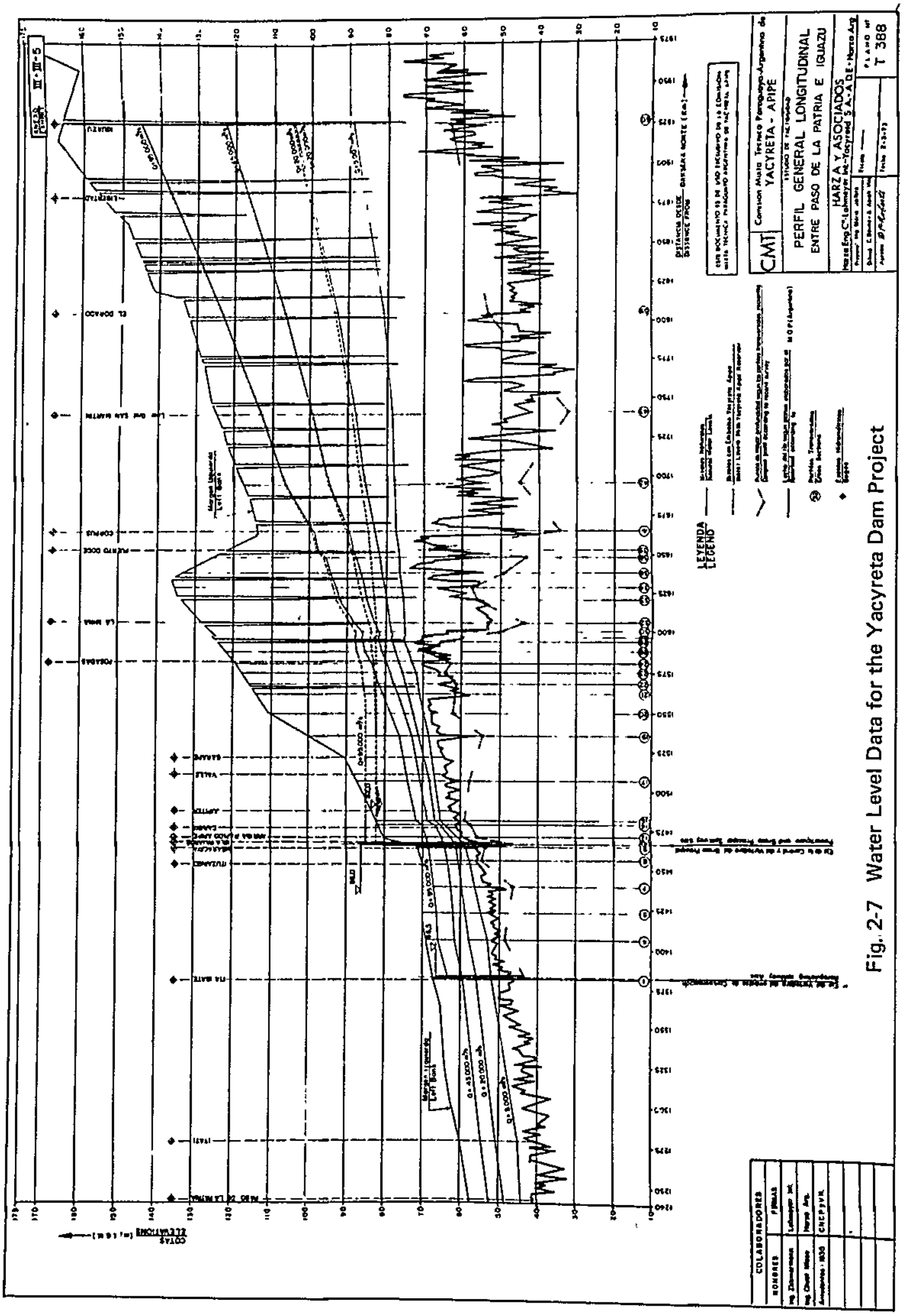


Fig. 2-7 Water Level Data for the Yacyreta Dam Project

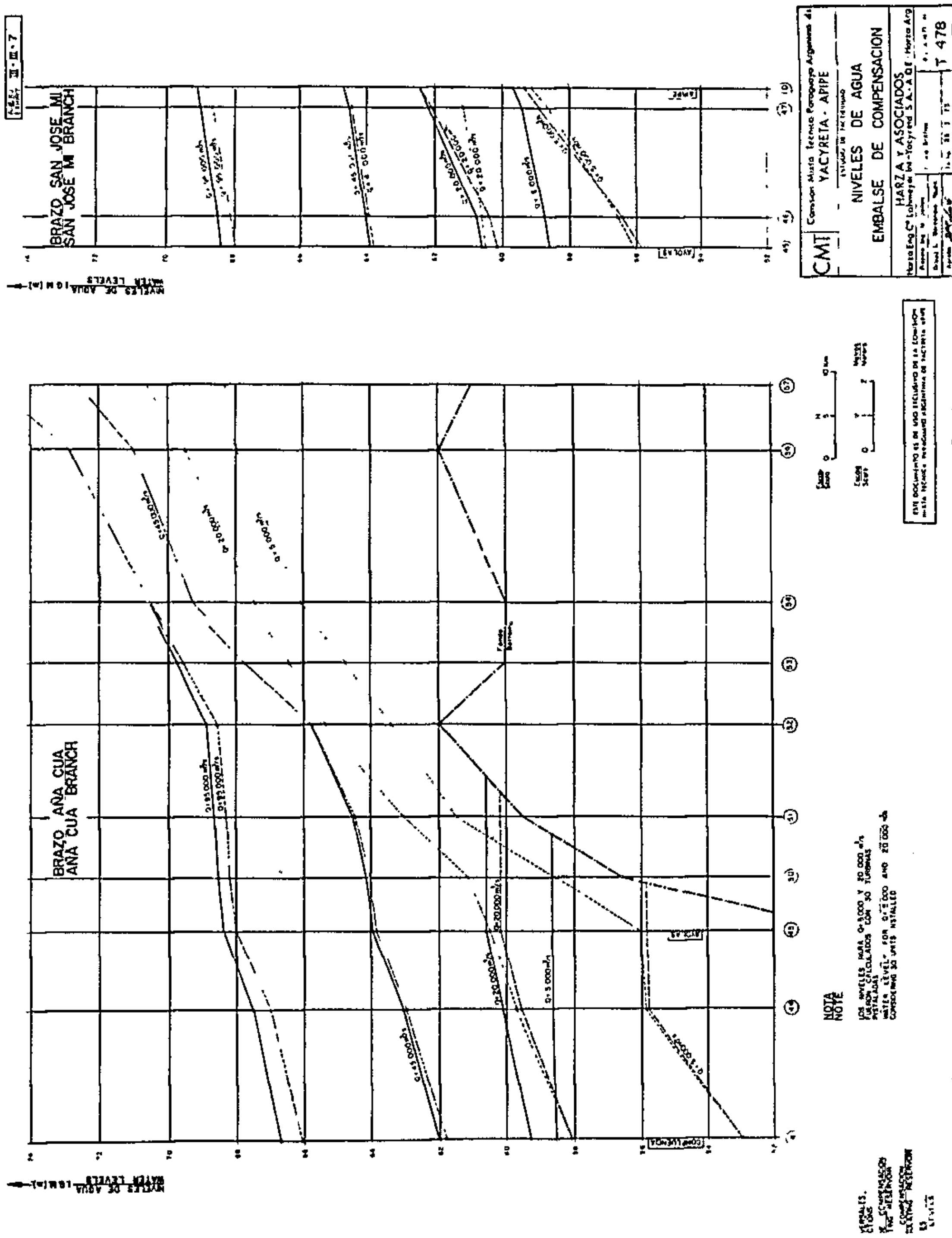


Fig. 2-8 Water Level Data for the Yacyreta Dam Project

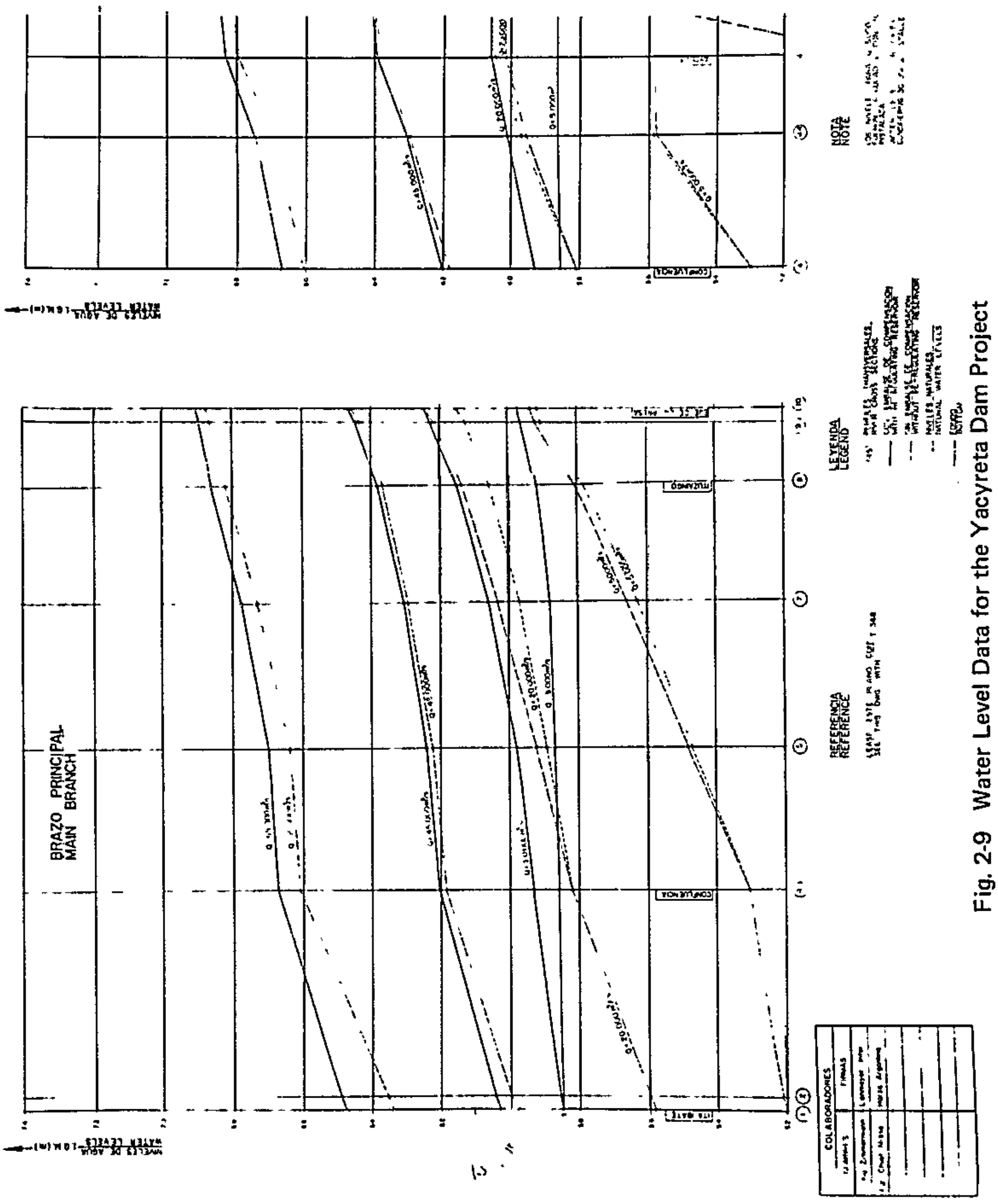


Fig. 2-9 Water Level Data for the Yacyreta Dam Project

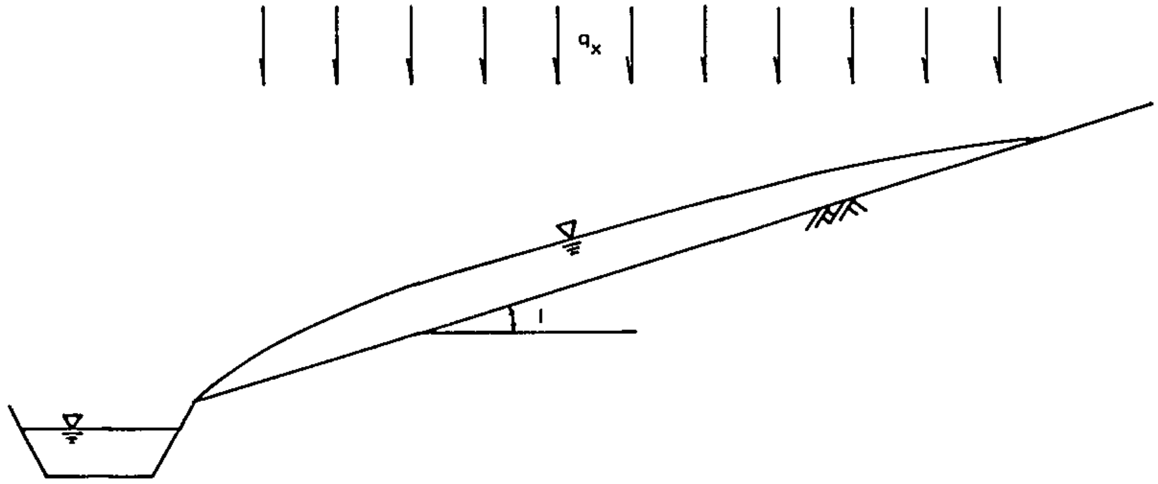


Fig. 3-1 Model of Runoff from Rainfall on a Uniform Slope

Table 3-1 List of Rainfall Loss

T	Amount of rainfall (R)	RL = 50 m/m			RL = 80 m/m			Notes
		Rainfall loss (RL)	Amount of direct runoff	Amount of hourly run-off	Rainfall loss (RL)	Amount of direct runoff	Amount of hourly run-off	
(hr)	(m/m)	(m/m)	(m/m)	(m/m)	(m/m)	(m/m)	(m/m)	
1	13.7	13.4	0.3	0.3	13.6	0.1	0.1	
2	27.4	25.6	1.8	1.5	26.9	0.5	0.4	
3	41.1	36.0	5.1	3.3	39.5	1.6	1.1	
4	54.8	43.9	10.9	5.8	51.0	3.8	2.2	
5	68.5	48.7	19.8	8.9	61.1	7.4	3.6	
6	82.2	49.9	32.2	12.4	69.3	12.9	5.5	
7	95.9	50.0	45.9	13.7	75.5	20.4	7.5	
8	109.6	50.0	59.6	13.7	79.1	30.5	10.1	
9	123.3	50.0	73.3	13.7	80.0	43.3	12.8	
10	137.0	50.0	87.0	13.7	80.0	57.0	13.7	
11	150.7	50.0	100.7	13.7	80.0	70.7	13.7	
12	164.4	50.0	114.4	13.7	80.0	84.4	13.7	

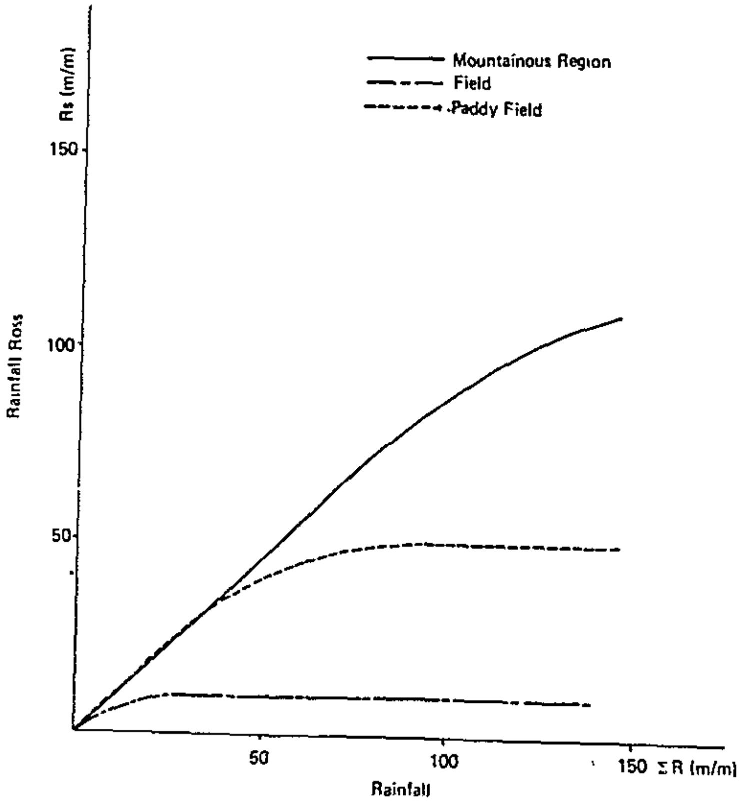


Fig. 3-2 (1) Example of Rainfall Loss

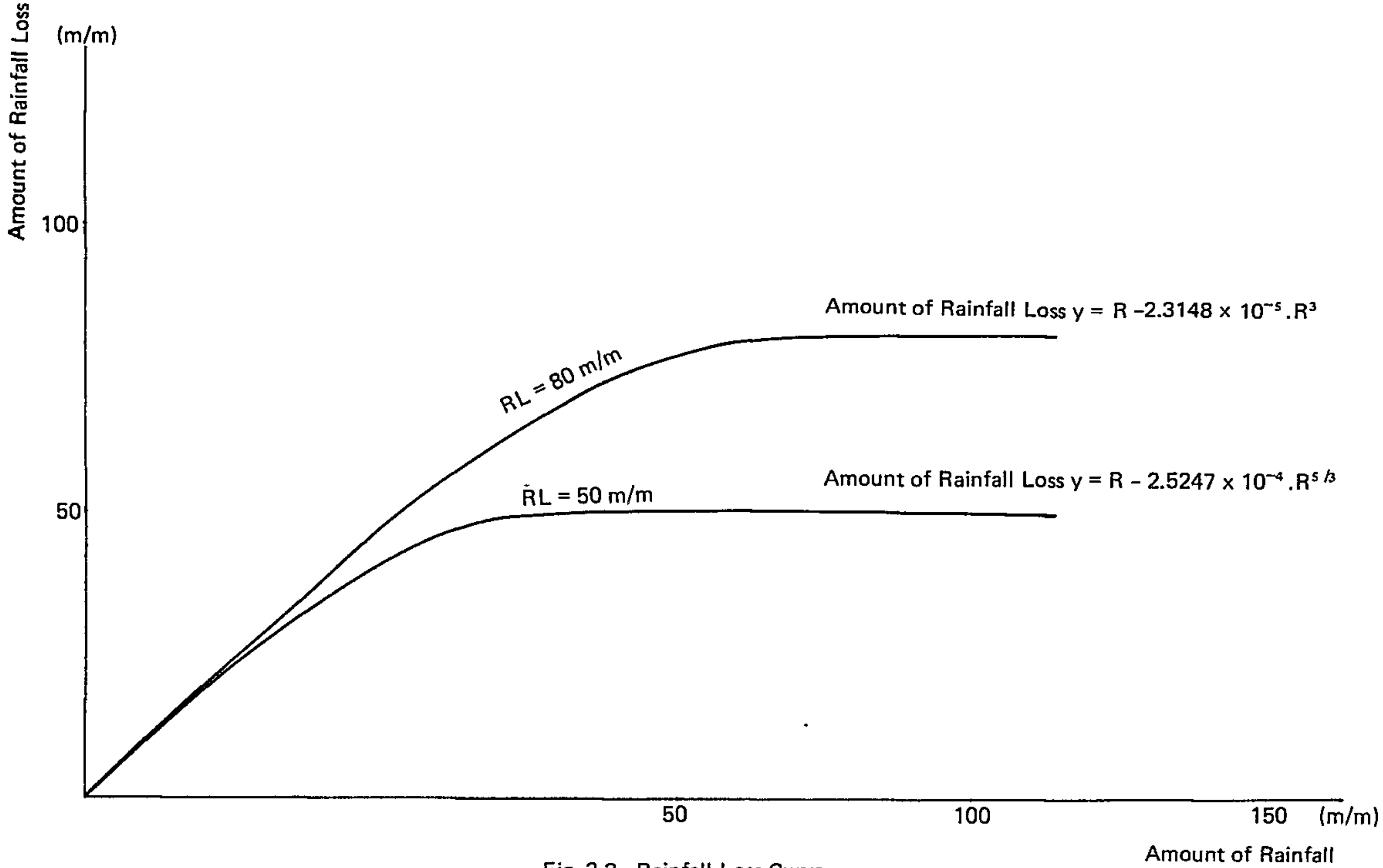


Fig. 3-2 Rainfall Loss Curve

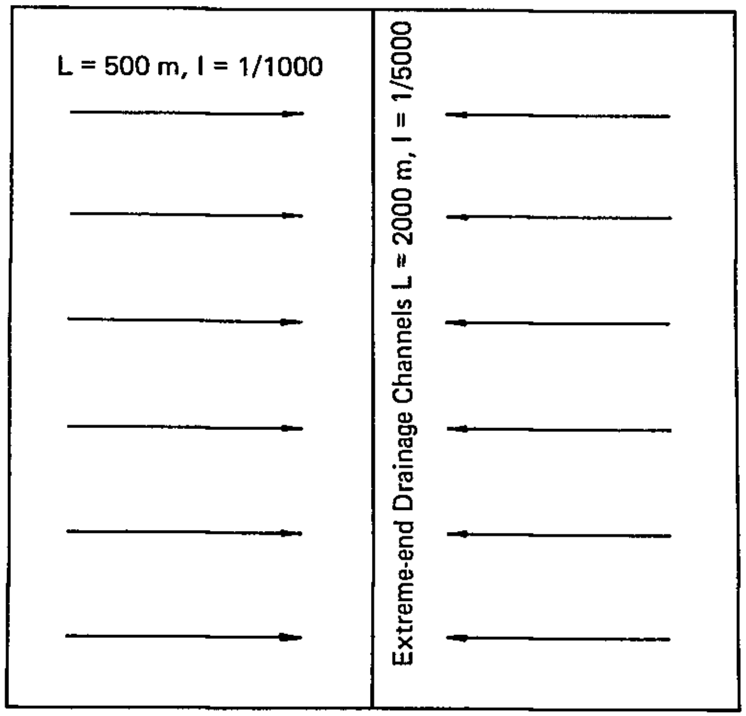


Fig. 3-3 On-farm Model

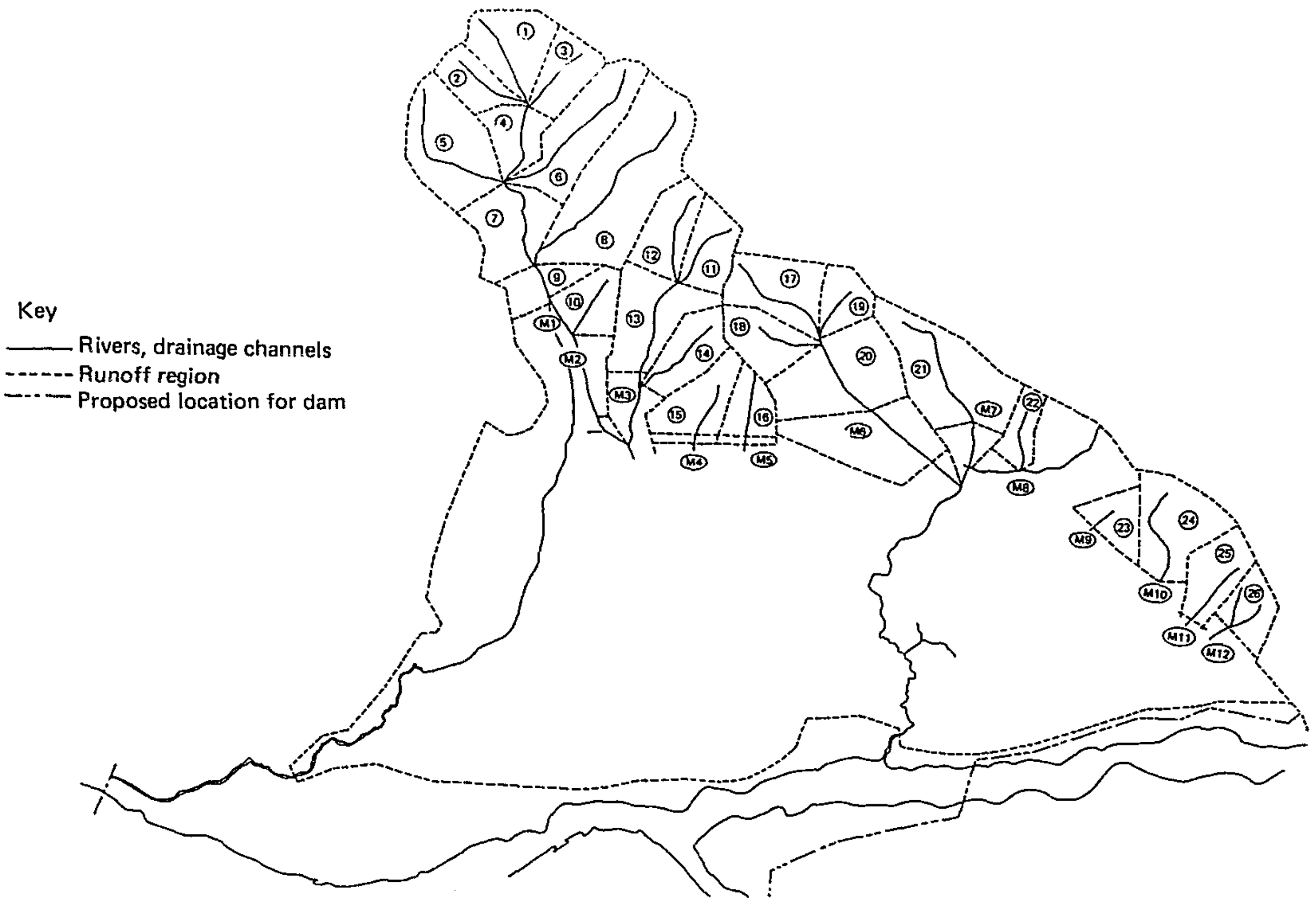


Fig. 3-4 Drainage System in the Hinterland

Table 3-2 Data for the Characteristic Curve Method

Block No.	No.	Catchment area	Average length of slope	Average slope gradient	River length	River gradient	Notes
		(km^2)	(m)		(m)		
M- 1	1	34.0	3,000	1/150	5,700	1/220	Verde
"	2	20.0	1,800	1/70	5,700	1/180	
"	3	26.0	1,900	1/70	7,000	1/300	Taihyity
"	4	26.0	2,600	1/100	5,000	1/500	Nangapé
"	5	50.0	1,900	1/70	13,000	1/250	Caje-cué
"	6	45.0	2,100	1/60	10,500	1/260	Cambay
"	7	26.0	1,900	1/100	7,000	1/1,100	Pikyry
"	8	104.0	3,200	1/100	16,500	1/300	Gonzalez
"	9	22.0	2,600	1/160	4,300	1/1,100	Cíervo Paso M1 Total 353.0 km^2
M- 2	10	16.0	1,600	1/70	5,000	1/110	
M- 3	11	28.0	2,000	1/70	6,800	1/220	Santa Teresa
"	12	26.0	1,700	1/70	7,700	1/190	
"	13	41.0	2,600	1/70	8,000	1/500	Toro-y
"	14	27.0	1,900	1/90	7,000	1/230	Yacare-y M3 Total 122.0 km^2
M- 4	15	19.0	2,100	1/110	4,500	1/220	Yacú Guy
M- 5	16	23.0	1,900	1/90	6,000	1/300	
M- 6	17	36.0	2,300	1/100	7,700	1/320	Ybú
"	18	35.0	2,400	1/120	7,300	1/330	Inguo
"	19	18.0	1,700	1/70	5,400	1/250	Cinbrón
"	20	45.0	4,100	1/120	5,500	1/800	Estero Tyecúa M6 Total 134.0 km^2
M- 7	21	83.0	3,000	1/130	14,000	1/400	
M- 8	22	13.0	1,700	1/100	3,800	1/130	
M- 9	23	33.0	3,400	1/150	4,900	1/330	
M-10	24	47.0	3,900	1/130	6,000	1/500	
M-11	25	13.0	1,400	1/90	4,500	1/300	
M-12	26	17.0	2,800	1/90	3,000	1/300	

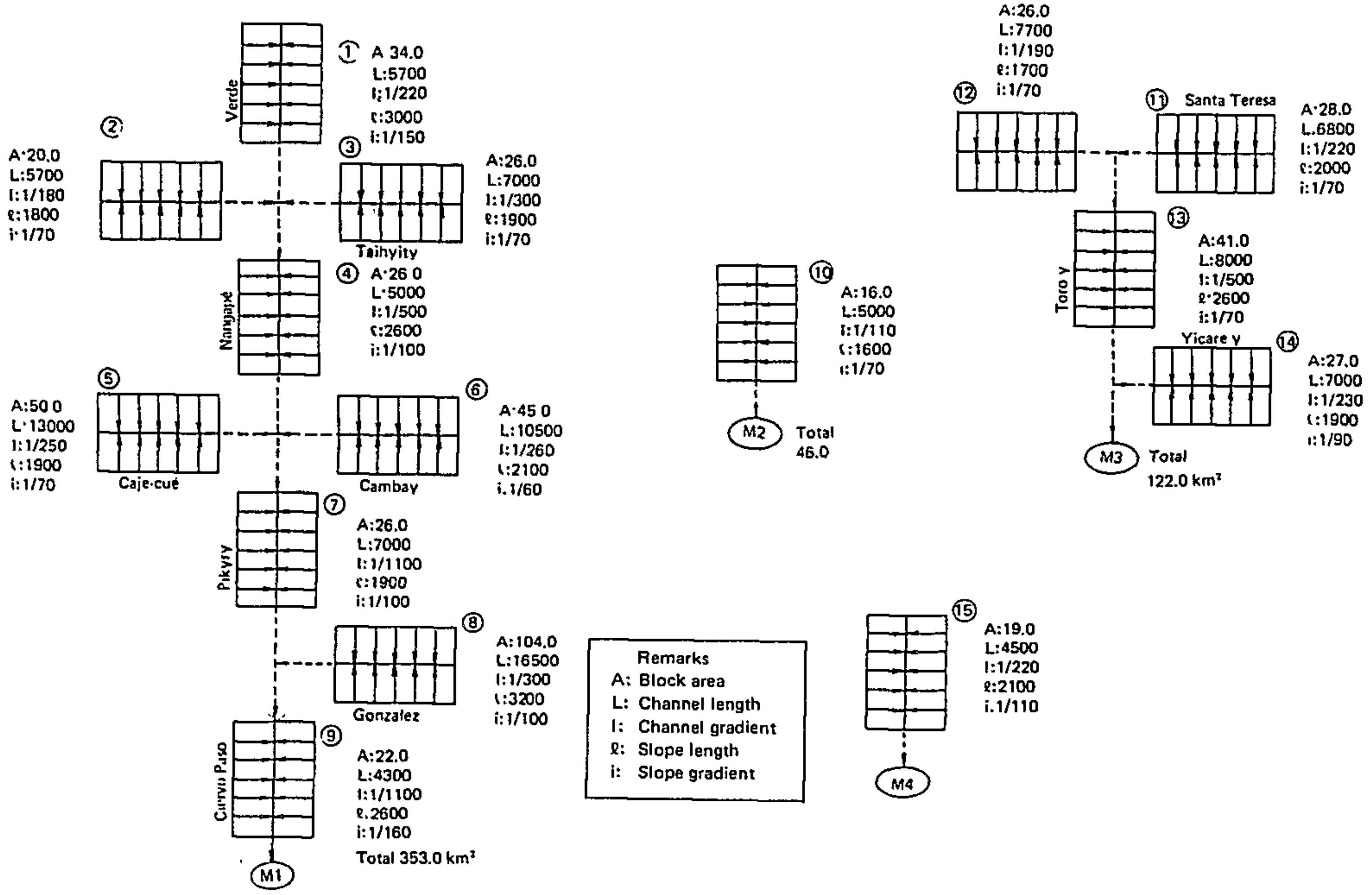


Fig. 3-5 Drainage System Map in the Hinterland

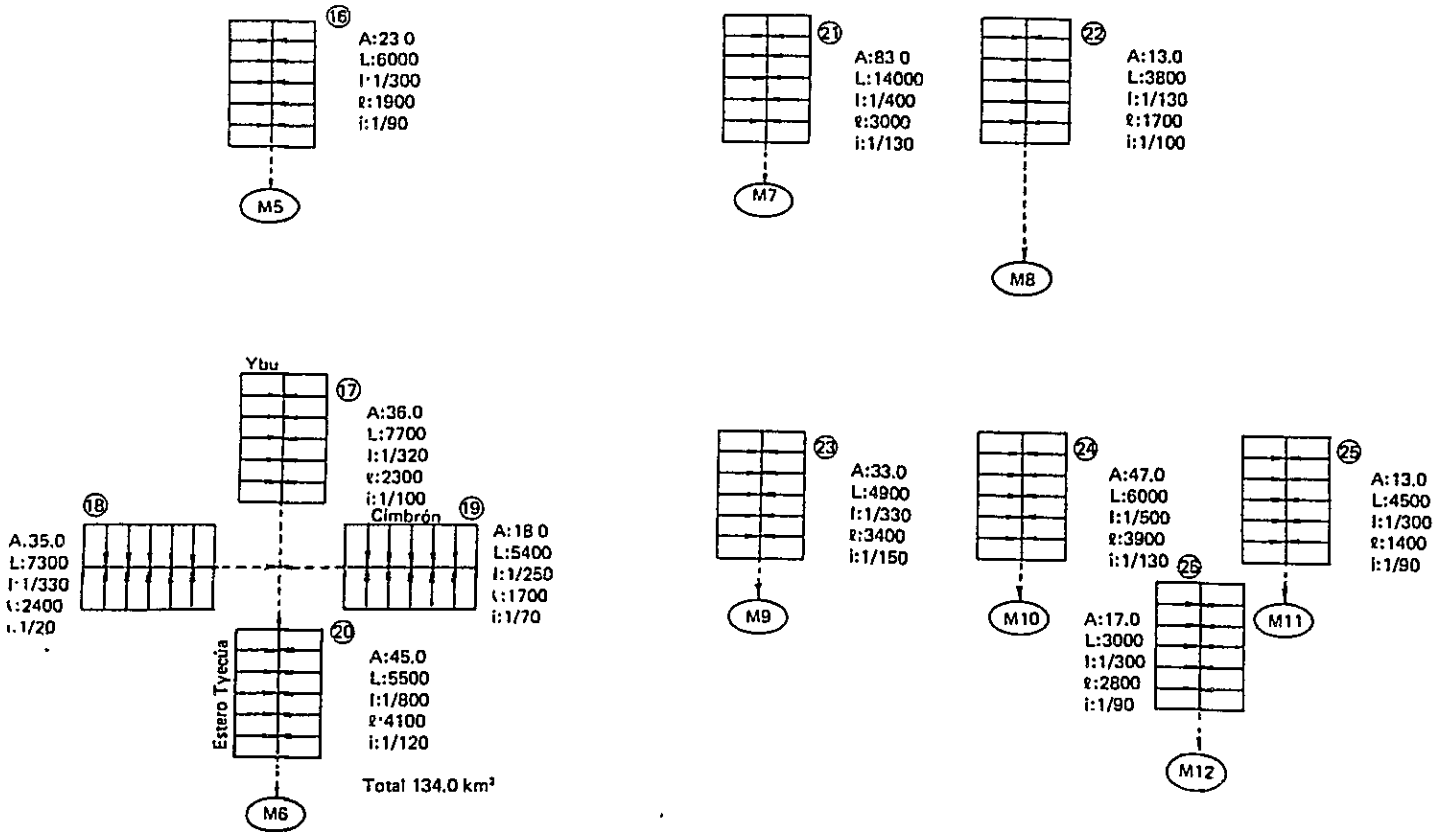


Fig. 3-6 Drainage System Map in the Hinterland

Table 3-3 Results of Calculation Based on the Characteristic Curve Method

RL = 0 m/m

HOR	RR(I)	M－1	M－2	M－3	M－4	M－5
1	13.70	102.76936	0.99227	0.15379	0.0	0.0
2	13.70	200.78670	4.23189	3.03876	0.87530	0.92444
3	13.70	304.63013	8.91413	69.79033	6.65384	9.77997
4	13.70	435.13086	16.14136	117.51631	11.48317	16.94737
5	13.70	575.95166	23.21942	165.14511	17.19586	25.56731
6	13.70	729.60400	34.23972	218.69434	23.87834	35.28137
7	13.70	873.18164	44.08008	283.32715	31.62613	46.32828
8	13.70	979.90674	54.42261	342.23901	40.52055	58.27785
9	13.70	1028.26567	60.46214	393.77979	49.02832	72.53262
10	13.70	1021.36938	60.68272	426.65088	57.65144	83.07605
11	13.70	966.04614	58.94948	422.89551	66.31085	84.86641
12	13.70	889.05542	52.70511	377.84277	64.31851	75.83360
13	0.0	780.47949	41.99289	314.82861	55.90865	63.89470
14	0.0	671.79443	33.33003	264.05151	46.72884	54.30869
15	0.0	578.66406	27.07861	219.31062	39.39760	44.90016
16	0.0	498.30298	22.19769	182.21788	33.54749	37.13777
17	0.0	428.81030	17.51411	153.89177	28.84027	31.38116
18	0.0	370.71899	14.37468	128.72496	24.72693	26.03146
19	0.0	321.80811	11.68468	109.00127	20.77663	21.81204
20	0.0	278.83423	9.62231	91.91818	17.77649	18.49626
21	0.0	243.78812	8.01747	77.76619	15.44326	15.54559
22	0.0	213.84419	6.70674	66.64368	13.18888	13.33788
23	0.0	188.28326	5.67191	57.37495	11.38603	11.34721
24	0.0	166.68082	4.84070	49.82437	9.99821	9.82034
25	0.0	147.68118	4.15563	43.19264	8.66480	8.49150
26	0.0	132.04309	3.62856	37.77213	7.61260	7.41452
27	0.0	117.92107	3.14866	33.35765	6.75129	6.52559
28	0.0	106.02269	2.77941	29.54999	5.94293	5.73229
29	0.0	95.27684	2.45737	26.28023	5.31845	5.10469
30	0.0	86.26706	2.18939	23.46767	4.74244	4.55092
31	0.0	78.08948	1.96327	21.06773	4.26404	4.07204
32	0.0	71.11661	1.76317	19.07397	3.84646	3.68010
33	0.0	64.84979	1.60554	17.25249	3.47447	3.31767
34	0.0	59.39980	1.44922	15.67522	3.17303	3.01342
35	0.0	54.54619	1.32214	14.33674	2.88115	2.75453
36	0.0	50.25696	1.22802	13.14668	2.64591	2.51159
37	0.0	46.45386	1.12791	12.08416	2.42182	2.31395
38	0.0	42.94366	1.03099	11.15042	2.23135	2.12926
39	0.0	39.89716	0.95182	10.30311	2.05762	1.95989
40	0.0	37.14403	0.89244	9.54179	1.90950	1.82495
41	0.0	34.62564	0.84252	8.89546	1.76609	1.70200
42	0.0	32.33476	0.79091	8.31989	1.64673	1.57422
43	0.0	30.23946	0.74010	7.77051	1.54012	1.46309
44	0.0	28.41104	0.69042	7.27651	1.43377	1.37841
45	0.0	26.73743	0.63880	6.83842	1.33963	1.30160
46	0.0	25.18246	0.59633	6.42498	1.26281	1.22544
47	0.0	23.76568	0.56987	6.04357	1.19302	1.15107
48	0.0	22.40425	0.54934	5.68509	1.12138	1.07445
49	0.0	21.15234	0.52939	5.38529	1.05166	1.01021
50	0.0	20.04102	0.50932	5.14448	0.99027	0.96451

RL = 0 m/m

HOR	RR(I)	M − 1	M − 2	M − 3	M − 4	M − 5
51	0.0	19.01727	0.48916	4.92044	0.94353	0.92455
52	0.0	18.07101	0.46928	4.69257	0.90023	0.88523
53	0.0	17.19765	0.44909	4.46747	0.85874	0.84595
54	0.0	16.41486	0.42915	4.24256	0.81491	0.80624
55	0.0	15.71092	0.40920	4.02226	0.77329	0.76731
56	0.0	15.03404	0.38906	3.83300	0.72979	0.72801
57	0.0	14.37909	0.36932	3.67896	0.69211	0.68844
58	0.0	13.74295	0.34940	3.53277	0.66397	0.64937
59	0.0	13.16247	0.32934	3.39573	0.64223	0.62068
60	0.0	12.64707	0.31054	3.27018	0.61966	0.60355
61	0.0	12.15659	0.29941	3.15061	0.59757	0.58775
62	0.0	11.67448	0.29535	3.03413	0.57556	0.57223
63	0.0	11.20220	0.29196	2.92326	0.55320	0.55664
64	0.0	10.74450	0.28860	2.82077	0.53144	0.54104
65	0.0	10.30890	0.28516	2.72434	0.50898	0.52551
66	0.0	9.91929	0.28174	2.62999	0.48718	0.50991
67	0.0	9.57585	0.27834	2.54373	0.46489	0.49435
68	0.0	9.25280	0.27496	2.47222	0.44294	0.47886
69	0.0	8.94963	0.27159	2.40785	0.42547	0.46320
70	0.0	8.66450	0.26817	2.34405	0.41428	0.44782
71	0.0	8.40043	0.26475	2.28008	0.40543	0.43216
72	0.0	8.15243	0.26135	2.21622	0.39681	0.41658
73	0.0	7.91271	0.25797	2.15216	0.38801	0.40114
74	0.0	7.68113	0.25460	2.09000	0.37924	0.38571
75	0.0	7.45533	0.25116	2.03485	0.37061	0.37009
76	0.0	7.24579	0.24775	1.98665	0.36184	0.35453
77	0.0	7.06095	0.24436	1.94008	0.35308	0.33906
78	0.0	6.89454	0.24100	1.89377	0.34449	0.32553
79	0.0	6.74649	0.23758	1.85238	0.33566	0.31732
80	0.0	6.61262	0.23416	1.81823	0.32697	0.31357
81	0.0	6.48034	0.23077	1.78631	0.31829	0.31093
82	0.0	6.34816	0.22741	1.75461	0.30952	0.30827
83	0.0	6.21624	0.22399	1.72296	0.30092	0.30561
84	0.0	6.08492	0.22058	1.69135	0.29211	0.30297
85	0.0	5.95755	0.21720	1.65979	0.28353	0.30034
86	0.0	5.83434	0.21382	1.62788	0.27471	0.29771
87	0.0	5.71440	0.21039	1.59607	0.26611	0.29505
88	0.0	5.59600	0.20700	1.56440	0.25734	0.29240
89	0.0	5.47760	0.20364	1.53275	0.24866	0.28976
90	0.0	5.35908	0.20021	1.50535	0.24003	0.28712
91	0.0	5.24077	0.19681	1.48627	0.23127	0.28449
92	0.0	5.12412	0.19345	1.47128	0.22265	0.28183
93	0.0	5.01755	0.19003	1.45634	0.21666	0.27918
94	0.0	4.92537	0.18663	1.44133	0.21411	0.27655
95	0.0	4.84088	0.18328	1.42634	0.21256	0.27392
96	0.0	4.76173	0.17985	1.41142	0.21108	0.27127
97	0.0	4.68640	0.17646	1.39647	0.20961	0.26862
98	0.0	4.61107	0.17308	1.38155	0.20814	0.26598
99	0.0	4.53598	0.16967	1.36655	0.20666	0.26336
100	0.0	4.46073	0.16632	1.35167	0.20518	0.26070

RL = 0 m/m

HOR	RR(I)	M − 1	M − 2	M − 3	M − 4	M − 5
101	0.0	4.38556	0.16289	1.33670	0.20369	0.25805
102	0.0	4.31037	0.15952	1.32175	0.20221	0.25542
103	0.0	4.23537	0.15612	1.30675	0.20074	0.25279
104	0.0	4.16152	0.15273	1.29186	0.19926	0.25014
105	0.0	4.09101	0.14935	1.27691	0.19779	0.24749
106	0.0	4.02570	0.14596	1.26201	0.19632	0.24486
107	0.0	3.96456	0.14258	1.24706	0.19483	0.24223
108	0.0	3.90501	0.13919	1.23219	0.19335	0.23957
109	0.0	3.84577	0.13581	1.21726	0.19187	0.23693
110	0.0	3.78648	0.13244	1.20230	0.19040	0.23431
111	0.0	3.72734	0.12904	1.18745	0.18892	0.23166
112	0.0	3.66802	0.12569	1.17256	0.18745	0.22901
113	0.0	3.60876	0.12230	1.15765	0.18597	0.22639
114	0.0	3.54960	0.11892	1.14281	0.18448	0.22375
115	0.0	3.49041	0.11557	1.12792	0.18300	0.22110
116	0.0	3.43129	0.11219	1.11300	0.18153	0.21847
117	0.0	3.36849	0.10881	1.09814	0.18006	0.21584
118	0.0	3.25132	0.10544	1.08329	0.17859	0.21319
119	0.0	2.88861	0.10209	1.06847	0.17710	0.21056
120	0.0	1.94809	0.09489	1.01714	0.16710	0.20012

RL = 0 m/m

HOR	RR(I)	M— 6	M — 7	M — 8	M — 9	M —10
1	13.70	1.03783	0.0	0.63938	0.0	0.0
2	13.70	32.16528	0.54694	2.68255	0.51732	0.48921
3	13.70	61.90793	18.28552	5.63615	6.09851	7.91942
4	13.70	95.26350	32.19891	10.24048	10.50111	13.76714
5	13.70	133.96617	48.43251	14.72210	16.07906	21.14082
6	13.70	178.28734	67.99490	21.75447	21.82732	29.36536
7	13.70	229.99051	89.44186	28.04616	29.65697	37.58626
8	13.70	274.67969	111.19621	34.81569	36.30228	49.11089
9	13.70	323.25464	139.80193	43.34857	45.92795	59.58090
10	13.70	365.72607	165.23734	48.18990	55.56253	71.45859
11	13.70	372.49170	196.79216	47.95285	64.49275	84.69110
12	13.70	344.46021	219.88988	43.08566	70.36601	92.48322
13	0.0	311.87549	229.96831	36.48961	72.74342	95.37845
14	0.0	280.90088	221.66988	30.66394	74.38376	97.43486
15	0.0	253.06177	199.16360	24.76401	75.88773	99.48880
16	0.0	230.45065	177.10976	20.36264	73.64687	100.61961
17	0.0	208.72742	155.68890	17.03069	66.55946	96.68361
18	0.0	184.64375	136.34409	14.34410	59.13857	87.96928
19	0.0	161.39873	120.59326	11.70313	52.74794	79.23366
20	0.0	141.54509	106.89481	9.81595	47.22957	71.55536
21	0.0	124.44200	93.64821	8.37011	42.44365	64.79375
22	0.0	109.73201	83.10353	6.97461	38.27541	57.73120
23	0.0	97.13638	73.67271	5.97520	34.23941	51.66875
24	0.0	86.36765	65.18675	5.11546	30.50569	46.50598
25	0.0	76.96681	58.45966	4.40067	27.36163	42.07915
26	0.0	69.02551	51.81154	3.84617	24.69156	38.25339
27	0.0	61.98479	46.53041	3.33496	22.40529	34.46249
28	0.0	55.99332	41.64459	2.95365	20.28406	31.09514
29	0.0	50.60687	37.54834	2.58829	18.26993	28.24251
30	0.0	45.84344	33.86154	2.31180	16.57681	25.80011
31	0.0	41.47743	30.68777	2.05075	15.13055	23.55278
32	0.0	37.75505	27.82945	1.84638	13.88593	21.40967
33	0.0	34.43887	25.36424	1.65552	12.62880	19.59039
34	0.0	31.55750	23.12526	1.50426	11.55067	18.02846
35	0.0	28.97733	21.22226	1.36033	10.62646	16.57294
36	0.0	26.71529	19.44579	1.24254	9.82765	15.21106
37	0.0	24.68488	17.95018	1.13181	9.02703	14.04371
38	0.0	22.84612	16.49249	1.04126	8.33689	13.03229
39	0.0	21.12946	15.26977	0.95580	7.74000	12.03451
40	0.0	19.61444	14.14883	0.88256	7.20350	11.15205
41	0.0	18.25148	13.13329	0.81642	6.67020	10.38755
42	0.0	17.01816	12.23782	0.75614	6.21401	9.67740
43	0.0	15.91908	11.39510	0.70392	5.81802	9.00691
44	0.0	14.91575	10.65526	0.65587	5.43415	8.42361
45	0.0	13.98691	9.96757	0.61262	5.08214	7.89765
46	0.0	13.12051	9.33087	0.57307	4.77098	7.38107
47	0.0	12.34157	8.77245	0.53877	4.49181	6.92985
48	0.0	11.64618	8.25804	0.50355	4.21735	6.53078
49	0.0	10.99514	7.76717	0.47368	3.97272	6.13037
50	0.0	10.38332	7.32993	0.44911	3.75796	5.77691

RL = 0 m/m

HOR	RR(I)	M-6	M-7	M-8	M-9	M-10
51	0.0	9.82513	6.94205	0.42424	3.54212	5.46409
52	0.0	9.32868	6.56472	0.40023	3.34927	5.15366
53	0.0	8.87725	6.20522	0.37728	3.18078	4.87597
54	0.0	8.44872	5.90420	0.35922	3.01167	4.62601
55	0.0	8.02273	5.61945	0.34281	2.85729	4.37711
56	0.0	7.62648	5.33382	0.32677	2.72307	4.15624
57	0.0	7.26400	5.06591	0.31051	2.59009	3.95409
58	0.0	6.91996	4.83223	0.29433	2.46125	3.75468
59	0.0	6.61042	4.63055	0.27986	2.35209	3.57667
60	0.0	6.33521	4.43244	0.26808	2.25145	3.41109
61	0.0	6.06857	4.22991	0.25848	2.14393	3.25008
62	0.0	5.80767	4.03154	0.24859	2.04577	3.10449
63	0.0	5.57462	3.65472	0.23904	1.96314	2.96672
64	0.0	5.35842	3.70730	0.22919	1.88423	2.83538
65	0.0	5.14940	3.57517	0.21955	1.80686	2.71484
66	0.0	4.95293	3.44210	0.20988	1.73178	2.59935
67	0.0	4.77457	3.30958	0.20015	1.65523	2.49174
68	0.0	4.61358	3.17931	0.19191	1.59114	2.39189
69	0.0	4.45658	3.04557	0.18581	1.53789	2.29495
70	0.0	4.29766	2.91626	0.18070	1.48325	2.20389
71	0.0	4.14192	2.81043	0.17564	1.42836	2.11893
72	0.0	3.99501	2.72687	0.17064	1.37496	2.03838
73	0.0	3.86872	2.64681	0.16557	1.32051	1.96218
74	0.0	3.75883	2.56763	0.16058	1.26916	1.88816
75	0.0	3.65041	2.48718	0.15550	1.22799	1.82035
76	0.0	3.54204	2.40815	0.15049	1.19198	1.75742
77	0.0	3.43403	2.32803	0.14546	1.15568	1.69196
78	0.0	3.32427	2.24810	0.14041	1.12013	1.63295
79	0.0	3.21799	2.16895	0.13545	1.08464	1.58018
80	0.0	3.12491	2.08957	0.13038	1.04815	1.52663
81	0.0	3.04769	2.01155	0.12535	1.01262	1.47463
82	0.0	2.97700	1.94896	0.12071	0.97687	1.42521
83	0.0	2.90658	1.90372	0.11736	0.94184	1.38073
84	0.0	2.83619	1.86179	0.11513	0.91459	1.33922
85	0.0	2.76614	1.82075	0.11315	0.89304	1.29633
86	0.0	2.69587	1.77887	0.11117	0.87120	1.25426
87	0.0	2.62479	1.73780	0.10917	0.84969	1.21539
88	0.0	2.55388	1.69602	0.10719	0.82850	1.18026
89	0.0	2.48319	1.65478	0.10520	0.80666	1.14743
90	0.0	2.41714	1.61334	0.10321	0.78501	1.11410
91	0.0	2.35918	1.57186	0.10125	0.76378	1.08084
92	0.0	2.30513	1.53092	0.09924	0.74210	1.04823
93	0.0	2.25126	1.48920	0.09727	0.72046	1.01760
94	0.0	2.19749	1.44788	0.09528	0.69932	0.99147
95	0.0	2.14315	1.40688	0.09330	0.67750	0.96607
96	0.0	2.08944	1.36543	0.09132	0.65614	0.74061
97	0.0	2.03667	1.32404	0.08933	0.63874	0.91573
98	0.0	1.99251	1.28285	0.08735	0.62613	0.89007
99	0.0	1.94963	1.24378	0.08537	0.61493	0.86495
100	0.0	1.90768	1.21353	0.08339	0.60388	0.84155

RL = 0 m/m

HOR	RR(I)	M－6	M－7	M－8	M－9	M－10
101	0.0	1.86592	1.19295	0.08142	0.59268	0.82127
102	0.0	1.82427	1.17607	0.07943	0.58141	0.80280
103	0.0	1.78206	1.15968	0.07747	0.57026	0.78389
104	0.0	1.74001	1.14345	0.07548	0.55924	0.76531
105	0.0	1.70374	1.12696	0.07350	0.54796	0.74679
106	0.0	1.67338	1.11070	0.07154	0.53674	0.72800
107	0.0	1.64400	1.09429	0.06956	0.52567	0.70964
108	0.0	1.61708	1.07796	0.06758	0.51453	0.69081
109	0.0	1.59355	1.06164	0.06562	0.50327	0.67391
110	0.0	1.57216	1.04526	0.06365	0.49218	0.65944
111	0.0	1.55144	1.02899	0.06177	0.48107	0.64617
112	0.0	1.53078	1.01258	0.06045	0.46981	0.63324
113	0.0	1.50999	0.99634	0.05981	0.45876	0.61998
114	0.0	1.48919	0.97992	0.05943	0.44757	0.60692
115	0.0	1.46840	0.96367	0.05909	0.43639	0.59389
116	0.0	1.44762	0.94727	0.05876	0.42539	0.58070
117	0.0	1.42687	0.93100	0.05843	0.41410	0.56777
118	0.0	1.40615	0.91466	0.05809	0.40318	0.55454
119	0.0	1.37517	0.89833	0.05775	0.39503	0.54154
120	0.0	1.15640	0.85338	0.05531	0.36646	0.50033

RL = 0 m/m

HOR	RR(I)	M— 11	M – 12	FIELD	M –	M –
1	13.70	0.0	1.75481	0.0		
2	13.70	0.92444	7.12438	0.00009		
3	13.70	7.40343	15.41038	0.00467		
4	13.70	12.53573	27.44887	0.00811		
5	13.70	16.78633	40.23663	0.01249		
6	13.70	26.54953	57.38376	0.01720		
7	13.70	34.70633	66.55296	0.02255		
8	13.70	43.91835	68.46181	0.02888		
9	13.70	48.67220	68.46181	0.03518		
10	13.70	49.28394	68.21127	0.03801		
11	13.70	47.65007	65.36992	0.03715		
12	13.70	41.77583	55.27269	0.03325		
13	0.0	34.32245	43.35425	0.02750		
14	0.0	28.10524	32.24059	0.02279		
15	0.0	22.22171	24.64095	0.01856		
16	0.0	18.20453	18.74092	0.01519		
17	0.0	14.58079	14.32928	0.01246		
18	0.0	11.94129	11.19785	0.01028		
19	0.0	9.70885	8.93820	0.00852		
20	0.0	8.09694	7.16359	0.00712		
21	0.0	6.65743	5.81645	0.00598		
22	0.0	5.60813	4.80593	0.00503		
23	0.0	4.75764	4.02274	0.00428		
24	0.0	4.04342	3.40743	0.00367		
25	0.0	3.48695	2.91405	0.00317		
26	0.0	3.03462	2.52395	0.00276		
27	0.0	2.63489	2.21042	0.00241		
28	0.0	2.31822	1.93818	0.00212		
29	0.0	2.05172	1.73057	0.00189		
30	0.0	1.83286	1.56168	0.00168		
31	0.0	1.64101	1.39451	0.00151		
32	0.0	1.47419	1.24547	0.00136		
33	0.0	1.33994	1.14084	0.00123		
34	0.0	1.21755	1.06349	0.00113		
35	0.0	1.10700	0.98677	0.00103		
36	0.0	1.01851	0.91080	0.00094		
37	0.0	0.94278	0.84460	0.00087		
38	0.0	0.86784	0.78962	0.00080		
39	0.0	0.79314	0.73692	0.00074		
40	0.0	0.73665	0.68492	0.00069		
41	0.0	0.69658	0.63416	0.00064		
42	0.0	0.65774	0.59789	0.00060		
43	0.0	0.61867	0.57497	0.00056		
44	0.0	0.57913	0.55320	0.00052		
45	0.0	0.54006	0.53149	0.00049		
46	0.0	0.50133	0.50976	0.00047		
47	0.0	0.47049	0.48895	0.00044		
48	0.0	0.45107	0.47415	0.00042		
49	0.0	0.43511	0.46472	0.00040		
50	0.0	0.41989	0.45570	0.00038		

RL = 0 m/m

HOR	RR(I)	M − 11	M − 12	FIELD	M −	M −
51	0.0	0.40417	0.44673	0.00035		
52	0.0	0.38885	0.43780	0.00033		
53	0.0	0.37333	0.42880	0.00032		
54	0.0	0.35783	0.41993	0.00030		
55	0.0	0.34256	0.41089	0.00029		
56	0.0	0.32708	0.40196	0.00029		
57	0.0	0.31158	0.39303	0.00028		
58	0.0	0.29616	0.38406	0.00027		
59	0.0	0.28079	0.37511	0.00026		
60	0.0	0.26542	0.36618	0.00025		
61	0.0	0.25015	0.35722	0.00024		
62	0.0	0.23963	0.34830	0.00023		
63	0.0	0.23524	0.33935	0.00022		
64	0.0	0.23250	0.33045	0.00021		
65	0.0	0.22987	0.32146	0.00021		
66	0.0	0.22726	0.31253	0.00020		
67	0.0	0.22463	0.30364	0.00019		
68	0.0	0.22198	0.29471	0.00018		
69	0.0	0.21935	0.28574	0.00017		
70	0.0	0.21673	0.27685	0.00016		
71	0.0	0.21410	0.26796	0.00016		
72	0.0	0.21146	0.25908	0.00016		
73	0.0	0.20883	0.25020	0.00016		
74	0.0	0.20622	0.24132	0.00015		
75	0.0	0.20358	0.23241	0.00015		
76	0.0	0.20094	0.22354	0.00015		
77	0.0	0.19831	0.21465	0.00015		
78	0.0	0.19571	0.20589	0.00015		
79	0.0	0.19305	0.19896	0.00015		
80	0.0	0.19042	0.19491	0.00014		
81	0.0	0.18782	0.19208	0.00014		
82	0.0	0.18517	0.18943	0.00014		
83	0.0	0.18254	0.18631	0.00014		
84	0.0	0.17993	0.15273	0.00014		
85	0.0	0.17730	0.11222	0.00014		
86	0.0	0.17466	0.09254	0.00014		
87	0.0	0.17206	0.08162	0.00013		
88	0.0	0.16942	0.07453	0.00013		
89	0.0	0.16679	0.06932	0.00013		
90	0.0	0.16419	0.06507	0.00013		
91	0.0	0.16154	0.06134	0.00013		
92	0.0	0.15893	0.05831	0.00013		
93	0.0	0.15630	0.04165	0.00012		
94	0.0	0.15367	0.02206	0.00012		
95	0.0	0.15107	0.01307	0.00012		
96	0.0	0.14843	0.00857	0.00012		
97	0.0	0.14583	0.00608	0.00012		
98	0.0	0.14319	0.00456	0.00012		
99	0.0	0.14058	0.00357	0.00012		
100	0.0	0.13795	0.00289	0.00011		

RL = 0 m/m

HOR	RR(I)	M — 11	M — 12	FIELD	M —	M —
101	0.0	0.13534	0.00240	0.00011		
102	0.0	0.13271	0.00261	0.00011		
103	0.0	0.13011	0.00173	0.00011		
104	0.0	0.12748	0.00150	0.00011		
105	0.0	0.12488	0.00132	0.00011		
106	0.0	0.12225	0.00117	0.00011		
107	0.0	0.11964	0.00105	0.00010		
108	0.0	0.11702	0.00094	0.00010		
109	0.0	0.11441	0.00066	0.00010		
110	0.0	0.11181	0.00078	0.00010		
111	0.0	0.10919	0.00071	0.00010		
112	0.0	0.10657	0.00065	0.00010		
113	0.0	0.10397	0.00061	0.00009		
114	0.0	0.10137	0.00056	0.00009		
115	0.0	0.09875	0.00052	0.00009		
116	0.0	0.09614	0.00048	0.00009		
117	0.0	0.09353	0.00045	0.00009		
118	0.0	0.09093	0.00042	0.00009		
119	0.0	0.08833	0.00040	0.00009		
120	0.0	0.08301	0.00038	0.00008		

RL = 50 m/m

HOR	RR(I)	M − 1	M − 2	M − 3	M − 4	M − 5
1	0.30	0.00001	0.0	0.00000	0.0	0.0
2	1.30	0.00002	0.00003	0.00004	0.00001	0.00001
3	3.50	0.00081	0.00488	0.00504	0.00213	0.00225
4	5.80	0.03005	0.21861	0.21862	0.09540	0.10076
5	8.90	0.52485	2.86457	25.99030	2.14376	3.12870
6	12.40	253.09106	6.58974	53.19937	4.86635	7.04100
7	13.70	371.45996	12.59511	91.32523	9.05047	13.15515
8	13.70	503.39453	20.27155	138.31752	14.21437	20.61925
9	13.70	628.69312	29.03584	190.68381	20.87804	29.45184
10	13.70	706.83301	39.43640	250.82903	27.15314	41.21548
11	13.70	710.30493	48.37952	294.67603	35.82613	51.15768
12	13.70	661.83936	50.62531	311.07471	41.65897	62.52948
13	0.0	606.22900	41.90202	293.51172	44.33311	61.99057
14	0.0	556.14307	33.32680	259.29858	43.41782	53.88145
15	0.0	511.66626	27.07861	218.34381	38.82973	44.82246
16	0.0	470.32593	22.19769	182.03679	33.42943	37.13388
17	0.0	421.52759	17.51411	153.86426	28.82236	31.38116
18	0.0	368.69214	14.37468	128.72498	24.72638	26.03146
19	0.0	321.13159	11.68468	109.00127	20.77663	21.81204
20	0.0	278.66113	9.62231	91.91818	17.77649	18.49626
21	0.0	243.75934	8.01747	77.76619	15.44326	15.54559
22	0.0	213.84067	6.70674	66.64368	13.18888	13.33788
23	0.0	188.28320	5.67191	57.37495	11.38603	11.34721
24	0.0	166.68082	4.84070	49.82437	9.99821	9.82034
25	0.0	147.68118	4.15563	43.19264	8.66480	8.49150
26	0.0	132.04309	3.62856	37.77213	7.61260	7.41452
27	0.0	117.92107	3.14866	33.35765	6.75129	6.52559
28	0.0	106.02269	2.77941	29.54999	5.94293	5.73229
29	0.0	95.27684	2.45737	26.28023	5.31845	5.10469
30	0.0	86.26706	2.18939	23.46767	4.74244	4.55092
31	0.0	78.08948	1.96327	21.06773	4.26404	4.07204
32	0.0	71.11661	1.76317	19.07397	3.84646	3.68010
33	0.0	64.84979	1.60554	17.25249	3.47447	3.31767
34	0.0	59.39980	1.44922	15.67522	3.17303	3.01342
35	0.0	54.54619	1.32214	14.33674	2.88115	2.75453
36	0.0	50.25696	1.22802	13.14668	2.64591	2.51159
37	0.0	46.45386	1.12791	12.08416	2.42152	2.31395
38	0.0	42.94366	1.03099	11.15042	2.23135	2.12926
39	0.0	39.89716	0.95182	10.30311	2.05762	1.95989
40	0.0	37.14403	0.89244	9.54179	1.90950	1.82495
41	0.0	34.62564	0.84252	8.89546	1.76609	1.70200
42	0.0	32.33476	0.79091	8.31989	1.64673	1.57422
43	0.0	30.23946	0.74010	7.77051	1.54012	1.46309
44	0.0	28.41104	0.69042	7.27651	1.43377	1.37841
45	0.0	26.73743	0.63880	6.83842	1.33963	1.30160
46	0.0	25.18246	0.59633	6.42498	1.26281	1.22544
47	0.0	23.76588	0.56987	6.04357	1.19302	1.15107
48	0.0	22.40425	0.54934	5.68509	1.12138	1.07445
49	0.0	21.15234	0.52939	5.38529	1.05166	1.01021
50	0.0	20.04102	0.50932	5.14448	0.99027	0.96451

RL = 50 m/m

HOR	RR(I)	M − 1	M − 2	M − 3	M − 4	M − 5
51	0.0	19.81727	0.48916	4.92044	0.94353	0.92455
52	0.0	18.57101	0.46928	4.69257	0.90023	0.88523
53	0.0	17.19765	0.44909	4.46747	0.85874	0.84595
54	0.0	16.41486	0.42915	4.24256	0.81491	0.80624
55	0.0	15.71002	0.40920	4.02226	0.77329	0.76731
56	0.0	15.03404	0.38906	3.83300	0.72979	0.72801
57	0.0	14.37909	0.36932	3.67896	0.69211	0.68844
58	0.0	13.74295	0.34940	3.53277	0.66397	0.64937
59	0.0	13.16247	0.32934	3.39573	0.64223	0.62068
60	0.0	12.64707	0.31054	3.27018	0.61965	0.60355
61	0.0	12.15659	0.29941	3.15061	0.59757	0.58775
62	0.0	11.67448	0.29535	3.03413	0.57556	0.57223
63	0.0	11.20220	0.29196	2.92326	0.55320	0.55664
64	0.0	10.74450	0.28860	2.82077	0.53144	0.54104
65	0.0	10.30890	0.28516	2.72434	0.50898	0.52551
66	0.0	9.91929	0.28174	2.62999	0.48718	0.50991
67	0.0	9.57585	0.27834	2.54373	0.46489	0.49435
68	0.0	9.25280	0.27496	2.47222	0.44294	0.47886
69	0.0	8.94963	0.27159	2.40785	0.42547	0.46320
70	0.0	8.66450	0.26817	2.34405	0.41428	0.44782
71	0.0	8.40043	0.26475	2.28008	0.40543	0.43216
72	0.0	8.15243	0.26135	2.21622	0.39681	0.41658
73	0.0	7.91271	0.25797	2.15216	0.38801	0.40114
74	0.0	7.68113	0.25460	2.09000	0.37924	0.38571
75	0.0	7.45533	0.25116	2.03485	0.37061	0.37009
76	0.0	7.24579	0.24775	1.98665	0.36184	0.35453
77	0.0	7.06095	0.24436	1.94008	0.35308	0.33906
78	0.0	6.89454	0.24100	1.89377	0.34449	0.32553
79	0.0	6.74649	0.23758	1.85238	0.33566	0.31732
80	0.0	6.61262	0.23416	1.81823	0.32697	0.31357
81	0.0	6.48034	0.23077	1.78631	0.31829	0.31093
82	0.0	6.34816	0.22741	1.75461	0.30952	0.30827
83	0.0	6.21624	0.22399	1.72296	0.30092	0.30561
84	0.0	6.08492	0.22058	1.69135	0.29211	0.30297
85	0.0	5.95755	0.21720	1.65979	0.28353	0.30034
86	0.0	5.83434	0.21382	1.62788	0.27471	0.29771
87	0.0	5.71440	0.21039	1.59607	0.26611	0.29505
88	0.0	5.59600	0.20700	1.56440	0.25734	0.29240
89	0.0	5.47760	0.20364	1.53275	0.24866	0.28976
90	0.0	5.35908	0.20021	1.50535	0.24003	0.28712
91	0.0	5.24077	0.19681	1.48627	0.23127	0.28449
92	0.0	5.12412	0.19345	1.47123	0.22265	0.28183
93	0.0	5.01755	0.19003	1.45634	0.21666	0.27918
94	0.0	4.92537	0.18663	1.44133	0.21411	0.27655
95	0.0	4.84085	0.18328	1.42634	0.21256	0.27392
96	0.0	4.76173	0.17985	1.41142	0.21108	0.27127
97	0.0	4.68640	0.17646	1.39647	0.20961	0.26862
98	0.0	4.61107	0.17308	1.38155	0.20814	0.26598
99	0.0	4.53598	0.16967	1.36655	0.20666	0.26336
100	0.0	4.46073	0.16632	1.35167	0.20518	0.26070

RL = 50 m/m

HOR	RR(I)	M－1	M－2	M－3	M－4	M－5
101	0.0	4.38556	0.16289	1.33670	0.20369	0.25805
102	0.0	4.31037	0.15952	1.32175	0.20221	0.25542
103	0.0	4.23537	0.15612	1.30675	0.20074	0.25279
104	0.0	4.16152	0.15273	1.29186	0.19926	0.25014
105	0.0	4.09101	0.14935	1.27691	0.19779	0.24749
106	0.0	4.02570	0.14596	1.26201	0.19632	0.24486
107	0.0	3.96456	0.14258	1.24706	0.19483	0.24223
108	0.0	3.90501	0.13919	1.23219	0.19335	0.23957
109	0.0	3.84577	0.13581	1.21726	0.19187	0.23693
110	0.0	3.78648	0.13244	1.20230	0.19040	0.23431
111	0.0	3.72734	0.12904	1.18745	0.18692	0.23166
112	0.0	3.66802	0.12569	1.17256	0.18745	0.22901
113	0.0	3.60876	0.12230	1.15765	0.18597	0.22639
114	0.0	3.54960	0.11892	1.14281	0.18448	0.22375
115	0.0	3.49041	0.11557	1.12792	0.18300	0.22110
116	0.0	3.43129	0.11219	1.11300	0.18153	0.21847
117	0.0	3.36849	0.10881	1.09814	0.18006	0.21584
118	0.0	3.25132	0.10544	1.08329	0.17859	0.21319
119	0.0	2.88861	0.10209	1.06847	0.17710	0.21056
120	0.0	1.94809	0.09489	1.01714	0.16710	0.20012

RL = 50 m/m

HOR	RR(I)	M－6	M－7	M－8	M－9	M－10
1	0.30	0.00000	0.0	0.0	0.0	0.0
2	1.30	0.00002	0.00001	0.00002	0.00001	0.00000
3	3.50	0.00116	0.00133	0.00306	0.00126	0.00076
4	5.80	0.04736	0.05961	0.13224	0.05638	0.03875
5	8.90	0.84138	1.07305	1.82721	1.95792	0.75133
6	12.40	47.53993	13.40242	3.93543	4.45127	5.42042
7	13.70	77.67940	24.64554	7.87483	8.36645	10.14456
8	13.70	114.34761	40.40987	12.96163	13.22003	16.65721
9	13.70	153.98473	57.37091	19.01527	19.20848	23.97040
10	13.70	202.78770	77.26897	24.86632	25.99574	33.20372
11	13.70	232.38948	100.47508	30.38387	32.67054	42.27443
12	13.70	238.56911	114.05928	36.33305	36.95915	47.80682
13	0.0	236.00844	118.36491	35.84375	38.00256	49.06459
14	0.0	224.81659	121.25291	30.39059	38.70012	49.94191
15	0.0	205.56108	124.13289	24.57826	39.39708	50.81934
16	0.0	184.67015	127.00529	20.00288	40.09349	51.69498
17	0.0	166.70047	129.47456	16.46371	40.78937	52.56975
18	0.0	150.56161	127.67819	13.71038	41.48463	53.44348
19	0.0	136.83530	118.70718	11.54002	42.17935	54.31635
20	0.0	125.99297	106.16861	9.80642	42.64099	55.18834
21	0.0	116.63953	93.46910	8.36541	41.17355	55.87828
22	0.0	107.08752	83.06242	6.93114	37.66893	54.78145
23	0.0	96.44751	73.66734	5.86202	34.07265	50.93822
24	0.0	86.10368	65.18675	5.04127	30.45474	46.24225
25	0.0	76.87566	58.45966	4.39248	27.34753	41.98837
26	0.0	68.99684	51.81154	3.84485	24.69049	38.22452
27	0.0	61.97421	46.53041	3.31666	22.40529	34.45485
28	0.0	55.99217	41.64459	2.90609	20.28406	31.09491
29	0.0	50.60687	37.54834	2.57892	18.26993	28.24251
30	0.0	45.84344	33.86154	2.31163	16.57681	25.60011
31	0.0	41.47743	30.68777	2.04540	15.13055	23.55278
32	0.0	37.75505	27.82945	1.82792	13.88593	21.40967
33	0.0	34.43887	25.36424	1.65111	12.62880	19.59039
34	0.0	31.55750	23.12526	1.50410	11.55067	18.02846
35	0.0	28.97733	21.22226	1.35733	10.62646	16.57294
36	0.0	26.71529	19.44579	1.23322	9.82765	15.21106
37	0.0	24.68488	17.95018	1.13038	9.02703	14.04371
38	0.0	22.84612	16.49249	1.04115	8.33669	13.03229
39	0.0	21.12946	15.26977	0.95326	7.74000	12.03451
40	0.0	19.61444	14.14883	0.87930	7.20350	11.15205
41	0.0	18.25148	13.13329	0.81613	6.67020	10.38755
42	0.0	17.01816	12.23782	0.75576	6.21401	9.67740
43	0.0	15.91908	11.39510	0.70147	5.81802	9.00691
44	0.0	14.91575	10.65526	0.65491	5.43415	8.42361
45	0.0	13.98691	9.96757	0.61261	5.04214	7.89765
46	0.0	13.12051	9.33087	0.57238	4.77098	7.38107
47	0.0	12.34157	8.77245	0.53714	4.49181	6.92985
48	0.0	11.64618	8.25804	0.50342	4.21735	6.53078
49	0.0	10.99514	7.76717	0.47353	3.97272	6.13037
50	0.0	10.38332	7.32993	0.44817	3.75795	5.77691

RL = 50 m/m

HOR	RR(I)	M－6	M－7	M－8	M－9	M－10
51	0.0	9.82513	6.94205	0.42378	3.54212	5.46409
52	0.0	9.32868	6.56472	0.40022	3.34927	5.15366
53	0.0	8.87725	6.20522	0.37694	3.18078	4.87597
54	0.0	8.44872	5.90420	0.35862	3.01167	4.62601
55	0.0	8.02273	5.61945	0.34272	2.85729	4.37711
56	0.0	7.62648	5.33382	0.32674	2.72307	4.15624
57	0.0	7.26400	5.06591	0.31010	2.59009	3.95409
58	0.0	6.91996	4.83223	0.29407	2.46125	3.75468
59	0.0	6.61042	4.63055	0.27985	2.35209	3.57667
60	0.0	6.33521	4.43244	0.26796	2.25145	3.41109
61	0.0	6.06857	4.22991	0.25811	2.14393	3.25008
62	0.0	5.80767	4.03154	0.24851	2.04577	3.10449
63	0.0	5.57462	3.85472	0.23903	1.96314	2.96672
64	0.0	5.35842	3.70730	0.22905	1.88423	2.83538
65	0.0	5.14940	3.57517	0.21932	1.80686	2.71484
66	0.0	4.95293	3.44210	0.20988	1.73178	2.59935
67	0.0	4.77457	3.30958	0.20007	1.65523	2.49174
68	0.0	4.61358	3.17931	0.19178	1.59114	2.39189
69	0.0	4.45658	3.04557	0.18581	1.53789	2.29495
70	0.0	4.29766	2.91626	0.18069	1.48325	2.20389
71	0.0	4.14192	2.81043	0.17557	1.42836	2.11893
72	0.0	3.99501	2.72687	0.17052	1.37496	2.03838
73	0.0	3.86872	2.64681	0.16554	1.32051	1.96218
74	0.0	3.75883	2.56763	0.16057	1.26916	1.88816
75	0.0	3.65041	2.48718	0.15543	1.22799	1.82035
76	0.0	3.54204	2.40815	0.15040	1.19198	1.75742
77	0.0	3.43403	2.32803	0.14546	1.15568	1.69196
78	0.0	3.32427	2.24810	0.14039	1.12013	1.63295
79	0.0	3.21799	2.16895	0.13531	1.08464	1.58018
80	0.0	3.12491	2.08957	0.13038	1.04815	1.52663
81	0.0	3.04769	2.01155	0.12532	1.01262	1.47463
82	0.0	2.97700	1.94896	0.12067	0.97687	1.42521
83	0.0	2.90658	1.90372	0.11736	0.94184	1.38073
84	0.0	2.83619	1.86179	0.11512	0.91459	1.33922
85	0.0	2.76614	1.82075	0.11312	0.89304	1.29633
86	0.0	2.69587	1.77887	0.11113	0.87120	1.25426
87	0.0	2.62479	1.73780	0.10915	0.84969	1.21539
88	0.0	2.55388	1.69602	0.10719	0.82850	1.18026
89	0.0	2.48319	1.65478	0.10520	0.80666	1.14743
90	0.0	2.41714	1.61334	0.10319	0.78501	1.11410
91	0.0	2.35918	1.57186	0.10120	0.76378	1.08084
92	0.0	2.30513	1.53092	0.09923	0.74210	1.04823
93	0.0	2.25126	1.48920	0.09727	0.72046	1.01760
94	0.0	2.19749	1.44786	0.09527	0.69932	0.99147
95	0.0	2.14315	1.40688	0.09327	0.67750	0.96607
96	0.0	2.08944	1.36543	0.09129	0.65614	0.94061
97	0.0	2.03867	1.32404	0.08933	0.63874	0.91573
98	0.0	1.99251	1.28285	0.08735	0.62613	0.89007
99	0.0	1.94963	1.24378	0.08535	0.61493	0.86495
100	0.0	1.90768	1.21353	0.08337	0.60388	0.84155

RL = 50 m/m

HOR	RR(I)	M-6	M-7	M-8	M-9	M-10
101	0.0	1.86592	1.19295	0.08142	0.59268	0.82127
102	0.0	1.82427	1.17607	0.07942	0.58141	0.80280
103	0.0	1.76206	1.15968	0.07743	0.57026	0.78389
104	0.0	1.74001	1.14345	0.07547	0.55924	0.76531
105	0.0	1.70374	1.12696	0.07350	0.54796	0.74679
106	0.0	1.67338	1.11079	0.07151	0.53674	0.72800
107	0.0	1.64400	1.09429	0.06955	0.52567	0.70964
108	0.0	1.61708	1.07795	0.06757	0.51453	0.69081
109	0.0	1.59355	1.06164	0.06559	0.50327	0.67391
110	0.0	1.57216	1.04526	0.06365	0.49218	0.65944
111	0.0	1.55144	1.02899	0.06176	0.48107	0.64617
112	0.0	1.53078	1.01258	0.06044	0.46981	0.63324
113	0.0	1.50999	0.99634	0.05981	0.45876	0.61998
114	0.0	1.48919	0.97992	0.05943	0.44757	0.60692
115	0.0	1.46840	0.96367	0.05909	0.43639	0.59389
116	0.0	1.44762	0.94727	0.05876	0.42539	0.58070
117	0.0	1.42687	0.93100	0.05842	0.41410	0.56777
118	0.0	1.40615	0.91466	0.05808	0.40318	0.55454
119	0.0	1.37517	0.89833	0.05775	0.39503	0.54154
120	0.0	1.15640	0.85338	0.05334	0.36646	0.50033

RL = 50 m/m

HOR	RR(I)	M－11	M－12	FIELD	M－	M－
1	0.30	0.0	0.0	0.0		
2	1.30	0.00001	0.00005	0.00000		
3	3.50	0.00225	0.00807	0.00000		
4	5.80	0.10076	0.36141	0.00001		
5	8.90	2.34526	5.07534	0.00018		
6	12.40	5.35535	11.17984	0.00339		
7	13.70	10.02401	21.80905	0.00647		
8	13.70	15.84339	34.94565	0.01034		
9	13.70	23.03929	49.17969	0.01486		
10	13.70	29.69830	62.52257	0.02020		
11	13.70	38.72086	65.00545	0.02585		
12	13.70	39.73004	55.25603	0.02923		
13	0.0	34.24353	43.35425	0.02718		
14	0.0	28.09784	32.24059	0.02276		
15	0.0	22.22171	24.64095	0.01855		
16	0.0	18.20453	18.74092	0.01519		
17	0.0	14.58079	14.32928	0.01246		
18	0.0	11.94129	11.19785	0.01028		
19	0.0	9.70885	8.93820	0.00852		
20	0.0	8.09694	7.16359	0.00712		
21	0.0	6.65743	5.81645	0.00598		
22	0.0	5.60813	4.80593	0.00503		
23	0.0	4.75764	4.02274	0.00428		
24	0.0	4.04342	3.40743	0.00367		
25	0.0	3.48695	2.91405	0.00317		
26	0.0	3.03462	2.52395	0.00276		
27	0.0	2.63489	2.21042	0.00241		
28	0.0	2.31822	1.93818	0.00212		
29	0.0	2.05172	1.73057	0.00189		
30	0.0	1.83286	1.56168	0.00168		
31	0.0	1.64101	1.39451	0.00151		
32	0.0	1.47419	1.24547	0.00136		
33	0.0	1.33994	1.14084	0.00123		
34	0.0	1.21755	1.06349	0.00113		
35	0.0	1.10700	0.98677	0.00103		
36	0.0	1.01851	0.91080	0.00094		
37	0.0	0.94278	0.84460	0.00087		
38	0.0	0.86784	0.78962	0.00060		
39	0.0	0.79314	0.73692	0.00074		
40	0.0	0.73665	0.68492	0.00069		
41	0.0	0.69658	0.63416	0.00064		
42	0.0	0.65774	0.59789	0.00060		
43	0.0	0.61867	0.57497	0.00056		
44	0.0	0.57913	0.55320	0.00052		
45	0.0	0.54006	0.53149	0.00049		
46	0.0	0.50133	0.50976	0.00047		
47	0.0	0.47049	0.48695	0.00044		
48	0.0	0.45107	0.47415	0.00042		
49	0.0	0.43511	0.46472	0.00040		
50	0.0	0.41969	0.45570	0.00038		

RL = 50 m/m

HOR	RR(I)	M − 11	M − 12	FIELD	M −	M −
51	0.0	0.40417	0.44673	0.00035		
52	0.0	0.38885	0.43780	0.00033		
53	0.0	0.37333	0.42880	0.00032		
54	0.0	0.35783	0.41993	0.00030		
55	0.0	0.34256	0.41069	0.00029		
56	0.0	0.32708	0.40196	0.00029		
57	0.0	0.31158	0.39303	0.00028		
58	0.0	0.29616	0.38406	0.00027		
59	0.0	0.28079	0.37511	0.00026		
60	0.0	0.26542	0.36618	0.00025		
61	0.0	0.25015	0.35722	0.00024		
62	0.0	0.23963	0.34830	0.00023		
63	0.0	0.23524	0.33935	0.00022		
64	0.0	0.23250	0.33045	0.00021		
65	0.0	0.22987	0.32146	0.00021		
66	0.0	0.22726	0.31253	0.00020		
67	0.0	0.22463	0.30364	0.00019		
68	0.0	0.22198	0.29471	0.00018		
69	0.0	0.21935	0.28574	0.00017		
70	0.0	0.21673	0.27685	0.00016		
71	0.0	0.21410	0.26796	0.00016		
72	0.0	0.21146	0.25908	0.00016		
73	0.0	0.20883	0.25020	0.00016		
74	0.0	0.20622	0.24132	0.00015		
75	0.0	0.20358	0.23241	0.00015		
76	0.0	0.20094	0.22354	0.00015		
77	0.0	0.19831	0.21465	0.00015		
78	0.0	0.19571	0.20642	0.00015		
79	0.0	0.19305	0.28345	0.00015		
80	0.0	0.19042	0.31201	0.00014		
81	0.0	0.18782	0.22407	0.00014		
82	0.0	0.18517	0.19344	0.00014		
83	0.0	0.18254	0.18679	0.00014		
84	0.0	0.17993	0.18417	0.00014		
85	0.0	0.17730	0.18156	0.00014		
86	0.0	0.17466	0.17846	0.00014		
87	0.0	0.17206	0.14487	0.00013		
88	0.0	0.16942	0.10436	0.00013		
89	0.0	0.16679	0.08467	0.00013		
90	0.0	0.16419	0.07379	0.00013		
91	0.0	0.16154	0.06669	0.00013		
92	0.0	0.15893	0.06185	0.00013		
93	0.0	0.15630	0.04410	0.00012		
94	0.0	0.15367	0.02362	0.00012		
95	0.0	0.15107	0.01437	0.00012		
96	0.0	0.14843	0.00956	0.00012		
97	0.0	0.14583	0.00686	0.00012		
98	0.0	0.14319	0.00517	0.00012		
99	0.0	0.14058	0.00407	0.00012		
100	0.0	0.13795	0.00330	0.00011		

RL = 50 m/m

HOR	RR(I)	M – 11	M – 12	FIELD	M –	M –
101	0.0	0.13534	0.00274	0.00011		
102	0.0	0.13271	0.00230	0.00011		
103	0.0	0.13011	0.00197	0.00011		
104	0.0	0.12748	0.00171	0.00011		
105	0.0	0.12488	0.00149	0.00011		
106	0.0	0.12225	0.00132	0.00011		
107	0.0	0.11964	0.00118	0.00010		
108	0.0	0.11702	0.00106	0.00010		
109	0.0	0.11441	0.00096	0.00010		
110	0.0	0.11181	0.00087	0.00010		
111	0.0	0.10919	0.00079	0.00010		
112	0.0	0.10657	0.00073	0.00010		
113	0.0	0.10397	0.00067	0.00009		
114	0.0	0.10137	0.00062	0.00009		
115	0.0	0.09875	0.00057	0.00009		
116	0.0	0.09614	0.00054	0.00009		
117	0.0	0.09353	0.00050	0.00009		
118	0.0	0.09093	0.00046	0.00009		
119	0.0	0.08833	0.00043	0.00009		
120	0.0	0.08301	0.00041	0.00008		

RL = 80 m/m

HOR	RR(I)	M－1	M－2	M－3	M－4	M－5
1	0.10	0.00000	0.0	0.0	0.0	0.0
2	0.40	0.00000	0.00000	0.[illegible]	0.00000	0.00000
3	1.10	0.00001	0.00013	0.00004	0.00004	0.00004
4	2.20	0.00057	0.00563	0.00220	0.00183	0.00193
5	3.60	0.01238	0.11539	0.04692	0.04057	0.04785
6	5.50	0.15540	1.52457	0.61770	1.03745	0.54113
7	7.50	145.30031	3.37864	3.78933	2.20880	3.30531
8	10.10	233.90962	6.14861	7.56146	4.55738	6.43234
9	12.80	335.14209	11.97800	14.07237	8.26338	12.10229
10	13.70	419.86818	19.39447	22.39771	13.36059	19.06358
11	13.70	462.94189	28.52119	32.71756	19.23509	27.96402
12	13.70	464.91699	34.79614	40.27034	23.01688	34.57736
13	0.0	444.66357	35.53226	43.78127	24.41197	37.59860
14	0.0	413.56348	30.83803	45.84302	25.36774	39.35277
15	0.0	382.51562	25.47891	45.34113	26.35609	38.75690
16	0.0	352.61987	20.92683	41.19083	27.29338	35.02010
17	0.0	326.12915	17.26369	35.97356	26.45047	30.52148
18	0.0	302.18799	14.36527	30.18948	23.39926	25.63191
19	0.0	282.96631	11.64564	25.59659	20.24297	21.68831
20	0.0	261.32397	9.44566	21.74750	17.56259	18.44318
21	0.0	235.78937	7.87593	18.33981	15.35738	15.52641
22	0.0	209.50258	6.69965	15.73188	13.14642	13.33158
23	0.0	185.98943	5.66250	13.41412	11.36660	11.34721
24	0.0	165.36113	4.77766	11.60485	9.99181	9.82034
25	0.0	147.03412	4.12828	10.04331	8.66447	8.49150
26	0.0	131.68979	3.62842	8.75762	7.61260	7.41452
27	0.0	117.74925	3.13602	7.71617	6.75129	6.52559
28	0.0	105.94179	2.75280	6.77656	5.94293	5.73229
29	0.0	95.23238	2.45576	6.03653	5.31845	5.10469
30	0.0	86.24048	2.18671	5.38599	4.74244	4.55092
31	0.0	78.08147	1.94685	4.81338	4.26404	4.07204
32	0.0	71.11430	1.76095	4.34893	3.84646	3.68010
33	0.0	64.84911	1.60505	3.92266	3.47447	3.31767
34	0.0	59.39973	1.44199	3.56072	3.17303	3.01342
35	0.0	54.54619	1.32027	3.26012	2.88115	2.75453
36	0.0	50.25696	1.22796	2.97256	2.64591	2.51159
37	0.0	46.45386	1.12494	2.73555	2.42182	2.31395
38	0.0	42.94366	1.02891	2.52085	2.23135	2.12926
39	0.0	39.89716	0.95177	2.31924	2.05762	1.95989
40	0.0	37.14403	0.89133	2.15571	1.90950	1.82495
41	0.0	34.62564	0.84008	2.01251	1.76609	1.70200
42	0.0	32.33476	0.79061	1.86543	1.64673	1.57422
43	0.0	30.23946	0.73982	1.73042	1.54012	1.46309
44	0.0	28.41104	0.68768	1.62600	1.43377	1.37841
45	0.0	26.73743	0.63069	1.53782	1.33963	1.30160
46	0.0	25.18246	0.59603	1.44902	1.26281	1.22544
47	0.0	23.76588	0.56894	1.36249	1.19302	1.15107
48	0.0	22.40425	0.54898	1.27420	1.12138	1.07445
49	0.0	21.15234	0.52934	1.19460	1.05166	1.01021
50	0.0	20.04102	0.50927	1.13645	0.99027	0.96451

RL = 80 m/m

HOR	RR(I)	M − 1	M − 2	M − 3	M − 4	M − 5
51	0.0	19.01727	0.48875	1.09047	0.94355	0.92455
52	0.0	18.07101	0.46865	1.04448	0.90023	0.88523
53	0.0	17.19765	0.44900	0.99939	0.85874	0.84595
54	0.0	16.41486	0.42911	0.95307	0.81491	0.80624
55	0.0	15.71002	0.40864	0.90773	0.77329	0.76731
56	0.0	15.03404	0.38633	0.86255	0.72979	0.72801
57	0.0	14.37909	0.36930	0.81655	0.69211	0.68844
58	0.0	13.74295	0.34080	0.77108	0.66397	0.64937
59	0.0	13.16247	0.32928	0.73409	0.64223	0.62068
60	0.0	12.64707	0.31043	0.71025	0.61966	0.60355
61	0.0	12.15659	0.29935	0.69141	0.59757	0.58775
62	0.0	11.67448	0.29533	0.67360	0.57556	0.57223
63	0.0	11.20220	0.29196	0.65529	0.55320	0.55664
64	0.0	10.74450	0.28859	0.63740	0.53144	0.54104
65	0.0	10.30890	0.28516	0.61916	0.50898	0.52551
66	0.0	9.91929	0.28172	0.60130	0.48718	0.50991
67	0.0	9.57585	0.27830	0.58308	0.46489	0.49435
68	0.0	9.25280	0.27489	0.56531	0.44294	0.47886
69	0.0	8.94963	0.27148	0.54702	0.42547	0.46320
70	0.0	8.66450	0.26809	0.52907	0.41428	0.44782
71	0.0	8.40043	0.26471	0.51110	0.40543	0.43216
72	0.0	8.15243	0.26133	0.49295	0.39681	0.41658
73	0.0	7.91271	0.25796	0.47499	0.38801	0.40114
74	0.0	7.68113	0.25460	0.45714	0.37924	0.38571
75	0.0	7.45533	0.25115	0.43908	0.37061	0.37009
76	0.0	7.24579	0.24772	0.42101	0.36184	0.35453
77	0.0	7.06095	0.24431	0.40391	0.35308	0.33906
78	0.0	6.89454	0.24090	0.38517	0.34449	0.32553
79	0.0	6.74649	0.23751	0.37262	0.33566	0.31732
80	0.0	6.61262	0.23413	0.36728	0.32697	0.31357
81	0.0	6.48034	0.23077	0.36406	0.31829	0.31093
82	0.0	6.34816	0.22741	0.36101	0.30952	0.30827
83	0.0	6.21624	0.22398	0.35795	0.30092	0.30561
84	0.0	6.08492	0.22055	0.35491	0.29211	0.30297
85	0.0	5.95755	0.21713	0.35183	0.28353	0.30034
86	0.0	5.83434	0.21374	0.34875	0.27471	0.29771
87	0.0	5.71440	0.21035	0.34568	0.26611	0.29505
88	0.0	5.59600	0.20699	0.34263	0.25734	0.29240
89	0.0	5.47760	0.20364	0.33959	0.24866	0.28976
90	0.0	5.35908	0.20020	0.33650	0.24003	0.28712
91	0.0	5.24077	0.19677	0.33343	0.23127	0.28449
92	0.0	5.12412	0.19337	0.33037	0.22265	0.28183
93	0.0	5.01755	0.18998	0.32732	0.21666	0.27918
94	0.0	4.92537	0.18662	0.32426	0.21411	0.27655
95	0.0	4.84088	0.18328	0.32118	0.21256	0.27392
96	0.0	4.76173	0.17983	0.31811	0.21108	0.27127
97	0.0	4.68640	0.17641	0.31506	0.20961	0.26862
98	0.0	4.61107	0.17302	0.31201	0.20814	0.26598
99	0.0	4.53598	0.16965	0.30893	0.20666	0.26336
100	0.0	4.46073	0.16631	0.30586	0.20518	0.26070

RL = 80 m/m

HOR	RR(I)	M − 1	M − 2	M − 3	M − 4	M − 5
101	0.0	4.38556	0.16287	0.30281	0.20369	0.25805
102	0.0	4.31037	0.15948	0.29976	0.20221	0.25542
103	0.0	4.23537	0.15607	0.29668	0.20074	0.25279
104	0.0	4.16152	0.15272	0.29362	0.19926	0.25014
105	0.0	4.09101	0.14934	0.29057	0.19779	0.24749
106	0.0	4.02570	0.14591	0.28751	0.19632	0.24486
107	0.0	3.96456	0.14253	0.28443	0.19483	0.24223
108	0.0	3.90501	0.13919	0.28138	0.19335	0.23957
109	0.0	3.84577	0.13580	0.27834	0.19187	0.23693
110	0.0	3.78648	0.13238	0.27526	0.19040	0.23431
111	0.0	3.72734	0.12902	0.27219	0.18892	0.23166
112	0.0	3.66802	0.12569	0.26915	0.18745	0.22901
113	0.0	3.60876	0.12226	0.26608	0.18597	0.22639
114	0.0	3.54960	0.11889	0.26301	0.18448	0.22375
115	0.0	3.49041	0.11557	0.25997	0.18300	0.22110
116	0.0	3.43129	0.11214	0.25691	0.18153	0.21847
117	0.0	3.36849	0.10879	0.25384	0.18006	0.21584
118	0.0	3.25132	0.10543	0.25079	0.17859	0.21319
119	0.0	2.88861	0.10204	0.24774	0.17710	0.21056
120	0.0	1.94809	0.09130	0.23556	0.16710	0.20012

RL = 80 m/m

HOR	RR(I)	M— 6	M— 7	M— 8	M— 9	M—10
1	0.10	0.00000	0.0	0.0	0.0	0.0
2	0.40	0.00000	0.00000	0.00000	0.00000	0.00000
3	1.10	0.00002	0.00002	0.00005	0.00002	0.00001
4	2.20	0.00091	0.00114	0.00253	0.00108	0.00072
5	3.60	0.01987	0.02535	0.05562	0.02398	0.01722
6	5.50	0.25019	0.32015	0.85391	0.30781	0.22875
7	7.50	23.23927	6.29339	2.02477	2.12646	2.60176
8	10.10	42.96397	12.68365	3.86086	4.24090	5.22104
9	12.80	71.57175	23.08235	7.37587	7.35805	9.52251
10	13.70	106.06622	36.56514	11.79259	12.39644	15.62040
11	13.70	133.96790	54.09843	17.35579	17.82021	22.57599
12	13.70	145.82527	64.30785	20.95459	20.83740	26.70126
13	0.0	146.12094	66.58206	22.87082	21.41949	27.45111
14	0.0	143.25607	68.12549	23.66910	21.81645	27.96190
15	0.0	141.27353	69.66304	22.27687	22.21278	28.47163
16	0.0	138.77943	71.19551	19.12029	22.60864	28.98100
17	0.0	132.89148	72.72249	16.14185	23.00391	29.48949
18	0.0	123.15280	74.24442	13.60030	23.39877	29.99713
19	0.0	112.03708	75.76157	11.50367	23.79317	30.50398
20	0.0	102.06349	77.27376	9.79397	24.18721	31.01003
21	0.0	93.14432	78.78177	8.36048	24.58081	31.51537
22	0.0	85.50420	76.82388	6.93083	24.97403	32.02078
23	0.0	78.99181	70.28551	5.86202	25.36691	32.52504
24	0.0	73.55032	63.49710	5.04127	25.66815	33.02869
25	0.0	68.86913	57.42714	4.39248	25.19579	33.52025
26	0.0	64.92148	51.29535	3.84485	23.67052	33.77338
27	0.0	60.17091	46.27914	3.31666	21.80948	32.53084
28	0.0	54.92010	41.49875	2.90609	19.87485	30.02261
29	0.0	49.94165	37.47888	2.57892	18.04712	27.61893
30	0.0	45.42889	33.81952	2.31163	16.45192	25.42946
31	0.0	41.23573	30.66969	2.04540	15.06135	23.29688
32	0.0	37.61191	27.82637	1.82792	13.84809	21.26814
33	0.0	34.35297	25.36436	1.65111	12.60390	19.50999
34	0.0	31.50951	23.12483	1.50410	11.53929	17.98439
35	0.0	28.94536	21.22226	1.35733	10.62292	16.54619
36	0.0	26.69154	19.44579	1.23322	9.82743	15.19483
37	0.0	24.66982	17.95018	1.13038	9.02752	14.03287
38	0.0	22.83618	16.49249	1.04115	8.33653	13.02597
39	0.0	21.12282	15.26977	0.95326	7.73956	12.03046
40	0.0	19.61012	14.14883	0.87930	7.20350	11.15089
41	0.0	18.24986	13.13329	0.81613	6.67020	10.38776
42	0.0	17.01816	12.23782	0.75576	6.21401	9.67740
43	0.0	15.91908	11.39510	0.70147	5.81802	9.00691
44	0.0	14.91575	10.65526	0.65491	5.43415	8.42361
45	0.0	13.98691	9.96757	0.61261	5.08214	7.89765
46	0.0	13.12051	9.33087	0.57238	4.77098	7.38107
47	0.0	12.34157	8.77245	0.53714	4.49181	6.92985
48	0.0	11.64618	8.25804	0.50342	4.21735	6.53078
49	0.0	10.99514	7.76717	0.47353	3.97272	6.13037
50	0.0	10.34332	7.32993	0.44817	3.75796	5.77491

RL = 80 m/m

HOR	RR(I)	M-6	M-7	M-8	M-9	M-10
51	0.0	9.82513	6.94205	0.42378	3.54212	5.46409
52	0.0	9.32868	6.56472	0.40022	3.34927	5.15366
53	0.0	8.87725	6.23522	0.37694	3.18078	4.87597
54	0.0	8.44872	5.90420	0.35862	3.01167	4.62601
55	0.0	8.02273	5.61945	0.34272	2.85729	4.37711
56	0.0	7.62648	5.33382	0.32674	2.72307	4.15624
57	0.0	7.26400	5.06591	0.31010	2.59009	3.95409
58	0.0	6.91996	4.83223	0.29407	2.46125	3.75468
59	0.0	6.61042	4.63055	0.27985	2.35209	3.57667
60	0.0	6.33521	4.43244	0.26796	2.25145	3.41109
61	0.0	6.06857	4.22991	0.25811	2.14393	3.25008
62	0.0	5.80767	4.03154	0.24851	2.04577	3.10449
63	0.0	5.57462	3.85472	0.23903	1.96314	2.96672
64	0.0	5.35842	3.70730	0.22905	1.88423	2.83538
65	0.0	5.14940	3.57517	0.21932	1.80686	2.71484
66	0.0	4.95293	3.44210	0.20988	1.73178	2.59935
67	0.0	4.77457	3.30958	0.20007	1.65523	2.49174
68	0.0	4.61358	3.17931	0.19178	1.59114	2.39189
69	0.0	4.45658	3.04557	0.18581	1.53789	2.29495
70	0.0	4.29766	2.91626	0.18069	1.48325	2.20389
71	0.0	4.14192	2.81043	0.17557	1.42836	2.11893
72	0.0	3.99501	2.72687	0.17052	1.37496	2.03838
73	0.0	3.86872	2.64681	0.16554	1.32051	1.96218
74	0.0	3.75883	2.56763	0.16057	1.26916	1.88816
75	0.0	3.65041	2.48718	0.15543	1.22799	1.82035
76	0.0	3.54204	2.40815	0.15040	1.19198	1.75742
77	0.0	3.43403	2.32803	0.14546	1.15568	1.69196
78	0.0	3.32427	2.24810	0.14039	1.12013	1.63295
79	0.0	3.21799	2.16895	0.13531	1.08464	1.58018
80	0.0	3.12491	2.08957	0.13038	1.04815	1.52663
81	0.0	3.04769	2.01155	0.12532	1.01262	1.47463
82	0.0	2.97700	1.94896	0.12067	0.97687	1.42521
83	0.0	2.90658	1.90372	0.11736	0.94184	1.38073
84	0.0	2.83619	1.86179	0.11512	0.91459	1.33922
85	0.0	2.76614	1.82075	0.11312	0.89304	1.29633
86	0.0	2.69587	1.77887	0.11113	0.87120	1.25426
87	0.0	2.62479	1.73780	0.10915	0.84969	1.21539
88	0.0	2.55388	1.69602	0.10719	0.82850	1.18026
89	0.0	2.48319	1.65478	0.10520	0.80666	1.14743
90	0.0	2.41714	1.61334	0.10319	0.78501	1.11410
91	0.0	2.35918	1.57186	0.10120	0.76378	1.06084
92	0.0	2.30513	1.53092	0.09923	0.74210	1.04823
93	0.0	2.25126	1.48920	0.09727	0.72046	1.01760
94	0.0	2.19749	1.44788	0.09527	0.69932	0.99147
95	0.0	2.14315	1.40688	0.09327	0.67750	0.96607
96	0.0	2.08944	1.36543	0.09129	0.65614	0.94061
97	0.0	2.03867	1.32404	0.08933	0.63874	0.91573
98	0.0	1.99251	1.28285	0.08735	0.62613	0.89007
99	0.0	1.94963	1.24378	0.08535	0.61493	0.86495
100	0.0	1.90768	1.21353	0.08337	0.60388	0.84155

RL = 80 m/m

HOR	RR(I)	M− 6	M− 7	M− 8	M− 9	M−10
101	0.0	1.80592	1.19295	0.08142	0.59268	0.82127
102	0.0	1.82427	1.17607	0.07942	0.58141	0.80250
103	0.0	1.78206	1.15968	0.07743	0.57026	0.78389
104	0.0	1.74001	1.14345	0.07547	0.55924	0.76531
105	0.0	1.70374	1.12696	0.07350	0.54796	0.74679
106	0.0	1.67338	1.11070	0.07151	0.53674	0.72800
107	0.0	1.64400	1.09429	0.06955	0.52567	0.70964
108	0.0	1.61708	1.07796	0.06757	0.51453	0.69081
109	0.0	1.59355	1.06164	0.06559	0.50327	0.67391
110	0.0	1.57216	1.04526	0.06365	0.49218	0.65944
111	0.0	1.55144	1.02899	0.06176	0.48107	0.64617
112	0.0	1.53078	1.01258	0.06044	0.46981	0.63324
113	0.0	1.50999	0.99634	0.05981	0.45876	0.61998
114	0.0	1.48919	0.97992	0.05943	0.44757	0.60692
115	0.0	1.46840	0.96367	0.05909	0.43639	0.59389
116	0.0	1.44762	0.94727	0.05876	0.42539	0.58070
117	0.0	1.42687	0.93100	0.05842	0.41410	0.56777
118	0.0	1.40615	0.91466	0.05808	0.40318	0.55454
119	0.0	1.37517	0.89833	0.05775	0.39503	0.54154
120	0.0	1.15640	0.85338	0.05334	0.36646	0.50033

RL = 80 m/m

HOR	RR(I)	M— 11	M – 12	FIELD	M –	M –
1	0.10	0.0	0.0	0.0		
2	0.40	0.00000	0.00000	0.00000		
3	1.10	0.00004	0.00014	0.00000		
4	2.20	0.00193	0.00692	0.00000		
5	3.60	0.04285	0.15371	0.00000		
6	5.50	1.11146	2.49080	0.00005		
7	7.50	2.50369	5.42248	0.00045		
8	10.10	4.94519	10.79059	0.00327		
9	12.80	9.03362	20.06662	0.00589		
10	13.70	14.78935	32.64409	0.00945		
11	13.70	21.40334	46.52403	0.01381		
12	13.70	27.15582	50.18839	0.01747		
13	0.0	29.09059	42.14417	0.01949		
14	0.0	25.93013	31.93954	0.01940		
15	0.0	21.55658	24.59068	0.01753		
16	0.0	18.00558	18.73517	0.01476		
17	0.0	14.51211	14.32922	0.01232		
18	0.0	11.92526	11.19785	0.01024		
19	0.0	9.70445	8.93820	0.00851		
20	0.0	8.09694	7.16359	0.00711		
21	0.0	6.65743	5.81645	0.00598		
22	0.0	5.60813	4.80593	0.00503		
23	0.0	4.75764	4.02274	0.00428		
24	0.0	4.04342	3.40743	0.00367		
25	0.0	3.48695	2.91405	0.00317		
26	0.0	3.03462	2.52395	0.00276		
27	0.0	2.63489	2.21042	0.00241		
28	0.0	2.31822	1.93818	0.00212		
29	0.0	2.05172	1.73057	0.00189		
30	0.0	1.83286	1.56168	0.00168		
31	0.0	1.64101	1.39451	0.00151		
32	0.0	1.47419	1.24547	0.00136		
33	0.0	1.33994	1.14064	0.00123		
34	0.0	1.21755	1.06349	0.00113		
35	0.0	1.10700	0.98677	0.00103		
36	0.0	1.01851	0.91080	0.00094		
37	0.0	0.94278	0.84460	0.00087		
38	0.0	0.86784	0.78962	0.00080		
39	0.0	0.79314	0.73692	0.00074		
40	0.0	0.73665	0.68492	0.00069		
41	0.0	0.69658	0.63416	0.00064		
42	0.0	0.65774	0.59789	0.00060		
43	0.0	0.61867	0.57497	0.00056		
44	0.0	0.57913	0.55320	0.00052		
45	0.0	0.54006	0.53149	0.00049		
46	0.0	0.50133	0.50976	0.00047		
47	0.0	0.47049	0.48895	0.00044		
48	0.0	0.45107	0.47415	0.00042		
49	0.0	0.43511	0.46472	0.00040		
50	0.0	0.41989	0.45570	0.00038		

RL = 80 m/m

HOR	RR(I)	M − 11	M − 12	FIELD	M −	M −
51	0.0	0.40417	0.44673	0.00035		
52	0.0	0.38885	0.43760	0.00033		
53	0.0	0.37333	0.42860	0.00032		
54	0.0	0.35783	0.41993	0.00030		
55	0.0	0.34256	0.41089	0.00029		
56	0.0	0.32708	0.40196	0.00029		
57	0.0	0.31159	0.39303	0.00028		
58	0.0	0.29614	0.38406	0.00027		
59	0.0	0.28079	0.37511	0.00026		
60	0.0	0.26542	0.36618	0.00025		
61	0.0	0.25015	0.35722	0.00024		
62	0.0	0.23963	0.34830	0.00023		
63	0.0	0.23524	0.33935	0.00022		
64	0.0	0.23250	0.33045	0.00021		
65	0.0	0.22987	0.32146	0.00021		
66	0.0	0.22726	0.31253	0.00020		
67	0.0	0.22463	0.30364	0.00019		
68	0.0	0.22198	0.29471	0.00018		
69	0.0	0.21935	0.28574	0.00017		
70	0.0	0.21673	0.27685	0.00016		
71	0.0	0.21410	0.26796	0.00016		
72	0.0	0.21146	0.25908	0.00016		
73	0.0	0.20883	0.25020	0.00016		
74	0.0	0.20622	0.24132	0.00015		
75	0.0	0.20358	0.23241	0.00015		
76	0.0	0.20094	0.22354	0.00015		
77	0.0	0.19631	0.21465	0.00015		
78	0.0	0.19571	0.20718	0.00015		
79	0.0	0.19305	0.43872	0.00015		
80	0.0	0.19042	0.58847	0.00014		
81	0.0	0.18782	0.33989	0.00014		
82	0.0	0.18517	0.22142	0.00014		
83	0.0	0.18254	0.19081	0.00014		
84	0.0	0.17993	0.18417	0.00014		
85	0.0	0.17730	0.18156	0.00014		
86	0.0	0.17466	0.17894	0.00014		
87	0.0	0.17206	0.17583	0.00013		
88	0.0	0.16942	0.14225	0.00013		
89	0.0	0.16679	0.10174	0.00013		
90	0.0	0.16419	0.08207	0.00013		
91	0.0	0.16154	0.07117	0.00013		
92	0.0	0.15893	0.06444	0.00013		
93	0.0	0.15630	0.04575	0.00012		
94	0.0	0.15367	0.02493	0.00012		
95	0.0	0.15107	0.01515	0.00012		
96	0.0	0.14843	0.01013	0.00012		
97	0.0	0.14583	0.00728	0.00012		
98	0.0	0.14319	0.00549	0.00012		
99	0.0	0.14058	0.00432	0.00012		
100	0.0	0.13795	0.00350	0.00011		

RL = 80 m/m

HOR	RR(I)	M − 11	M − 12	FIELD	M −	M −
101	0.0	0.13534	0.00290	0.00011		
102	0.0	0.13271	0.00243	0.00011		
103	0.0	0.13011	0.00208	0.00011		
104	0.0	0.12748	0.00180	0.00011		
105	0.0	0.12488	0.00158	0.00011		
106	0.0	0.12225	0.00139	0.00011		
107	0.0	0.11964	0.00124	0.00010		
108	0.0	0.11702	0.00111	0.00010		
109	0.0	0.11441	0.00100	0.00010		
110	0.0	0.11181	0.00091	0.00010		
111	0.0	0.10919	0.00083	0.00010		
112	0.0	0.10657	0.00076	0.00010		
113	0.0	0.10397	0.00070	0.00009		
114	0.0	0.10137	0.00064	0.00009		
115	0.0	0.09875	0.00059	0.00009		
116	0.0	0.09614	0.00055	0.00009		
117	0.0	0.09353	0.00052	0.00009		
118	0.0	0.09093	0.00048	0.00009		
119	0.0	0.08833	0.00045	0.00009		
120	0.0	0.08301	0.00042	0.00008		

Table 3-4 List of Peak Runoff Discharge Based on the Characteristic Curve Method

Block No.	Catch-ment area	Amount of rainfall loss 0.0 m/m			Amount of rainfall loss 50 m/m			Amount of rainfall loss 80 m/m			Notes
		Amount of peak run-off	Peak time	Amount of peak run-off ratio	Amount of peak run-off	Peak time	Amount of peak run-off ratio	Amount of peak run-off	Peak time	Amount of peak run-off ratio	
	(km^2)	(m^3/sec)	(hr)	(m^3/sec/km^2)	(m^3/sec)	(hr)	(m^3/sec/km^2)	(m^3/sec)	(hr)	(m^3/sec/km^2)	
M- 1	353.0	1,028.3	9	2.91	710.3	11	2.01	464.9	12	1.32	
M- 2	16.0	60.7	10	3.79	50.6	12	3.16	35.5	13	2.22	
M- 3	122.0	426.7	10	3.50	311.1	12	2.55	201.8	13	1.65	
M- 4	19.0	66.3	11	3.49	44.3	13	2.33	27.3	16	1.44	
M- 5	23.0	84.9	11	3.69	62.5	12	2.72	39.4	14	1.71	
M- 6	134.0	372.5	11	2.78	238.6	12	1.78	146.1	13	1.09	
M- 7	83.0	230.0	13	2.77	129.5	17	1.56	78.8	21	0.95	
M- 8	13.0	48.2	10	3.71	36.3	12	2.79	23.7	14	1.82	
M- 9	33.0	75.9	15	2.30	39.7	12	1.20	25.7	24	0.78	
M-10	47.0	100.6	16	2.14	55.9	21	1.19	33.8	26	0.72	
M-11	13.0	49.3	10	3.79	39.7	12	3.05	29.1	13	2.24	
M-12	18.0	68.5	8	3.81	65.0	11	3.61	50.2	12	2.79	

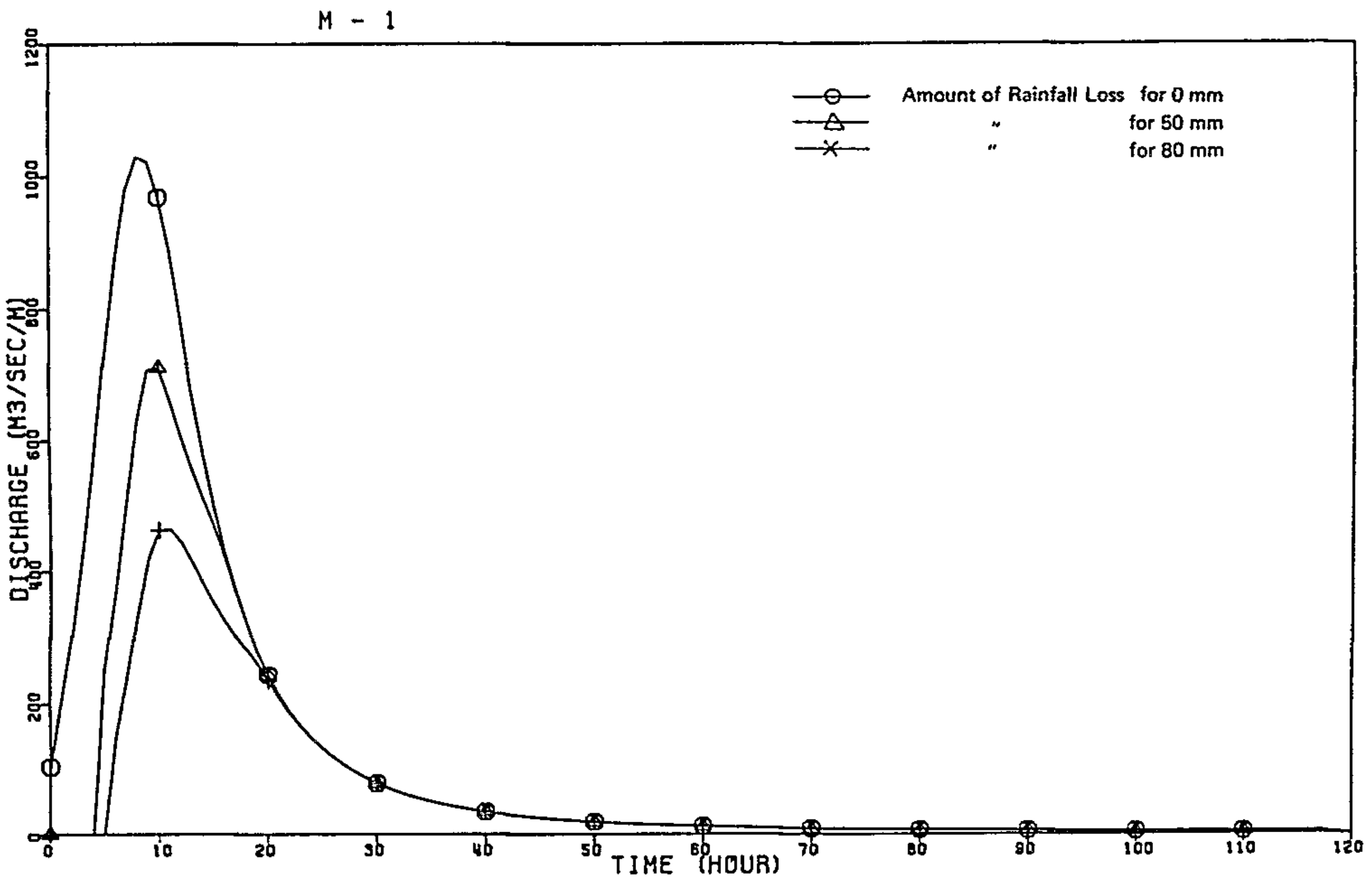


Fig. 3-7 Runoff Discharge Curve Based on the Characteristic Curve Method

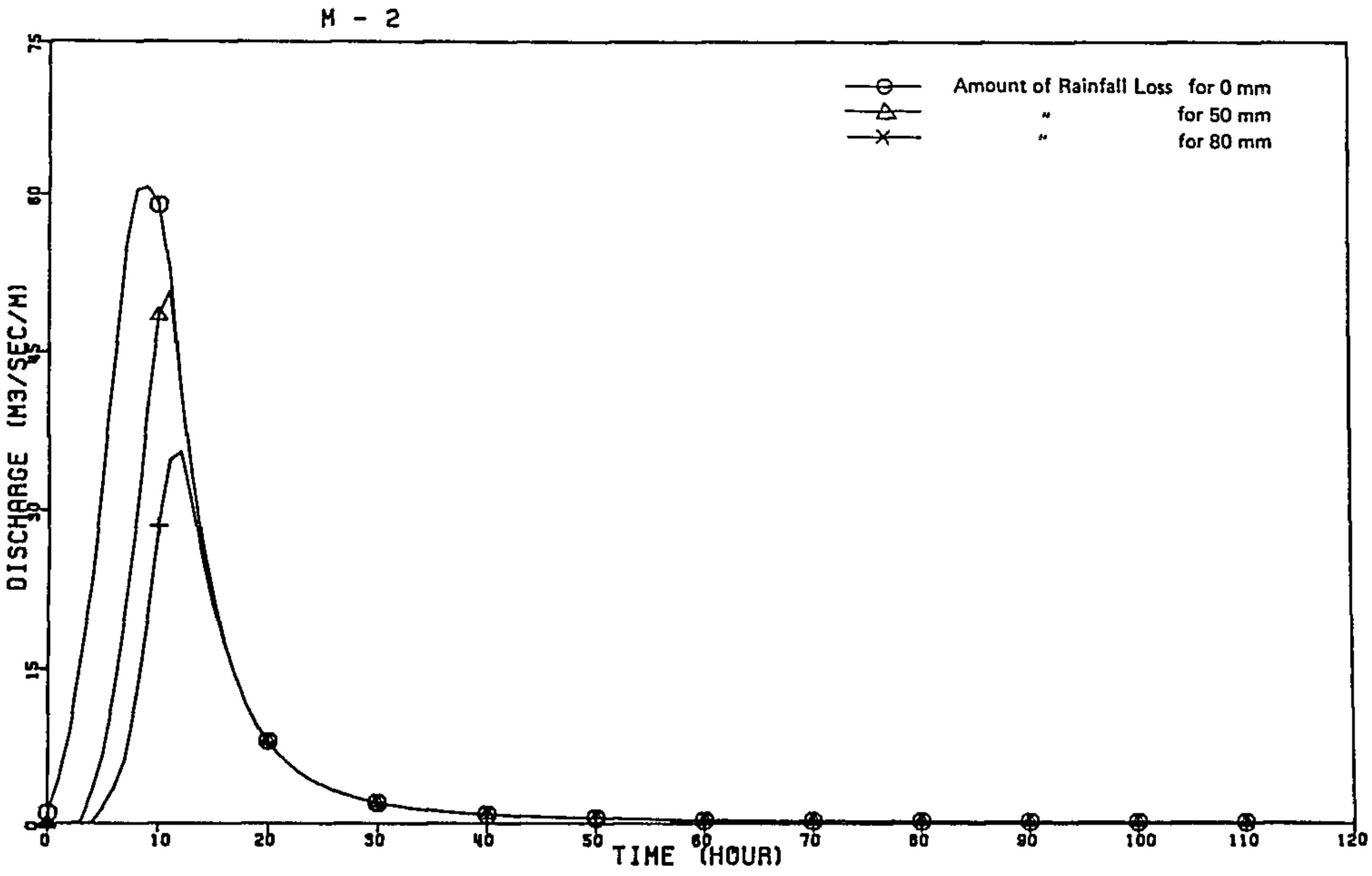


Fig. 3-8 Runoff Discharge Curve Based on the Characteristic Curve Method

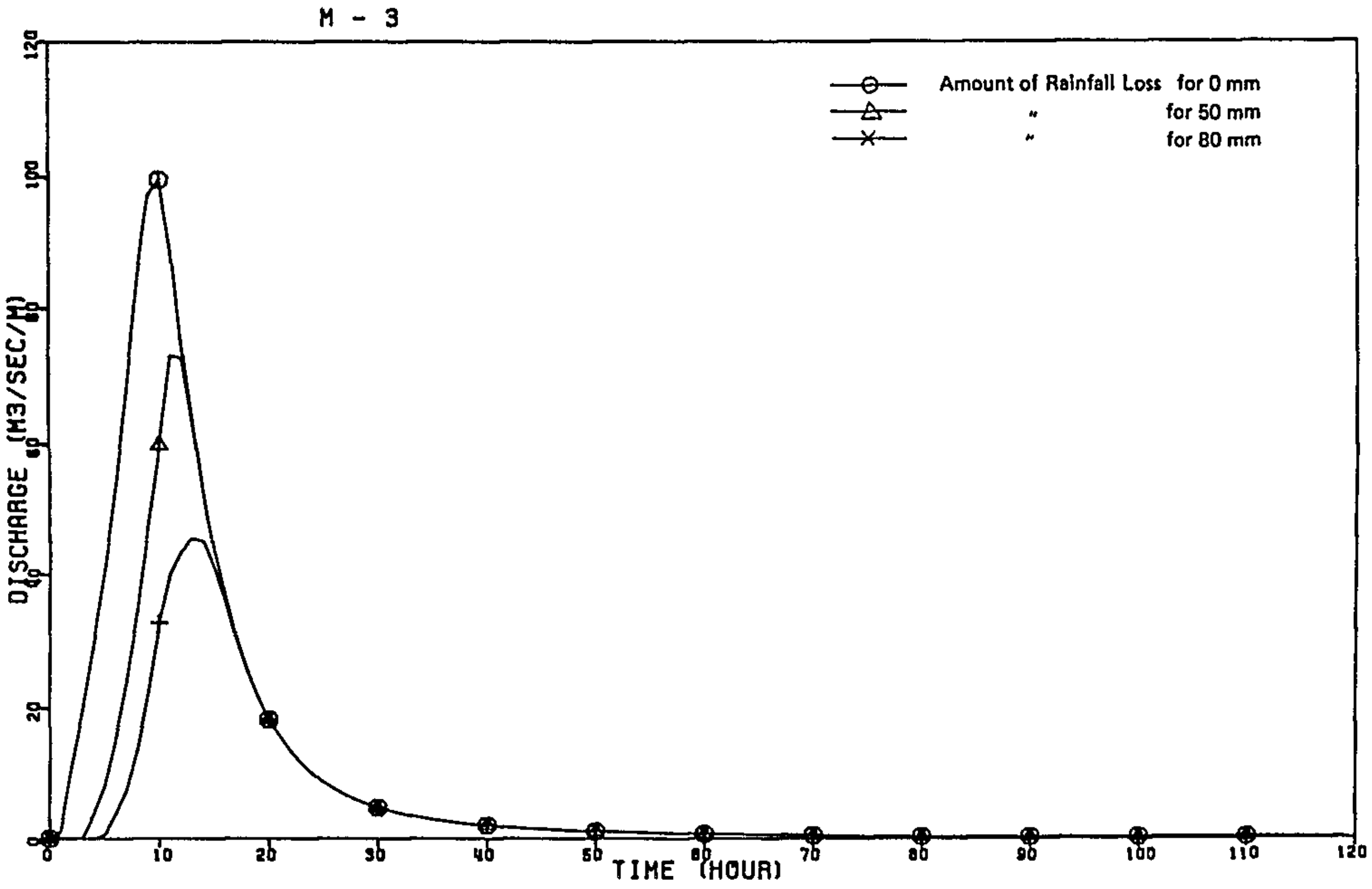


Fig. 3-9 Runoff Discharge Curve Based on the Characteristic Curve Method

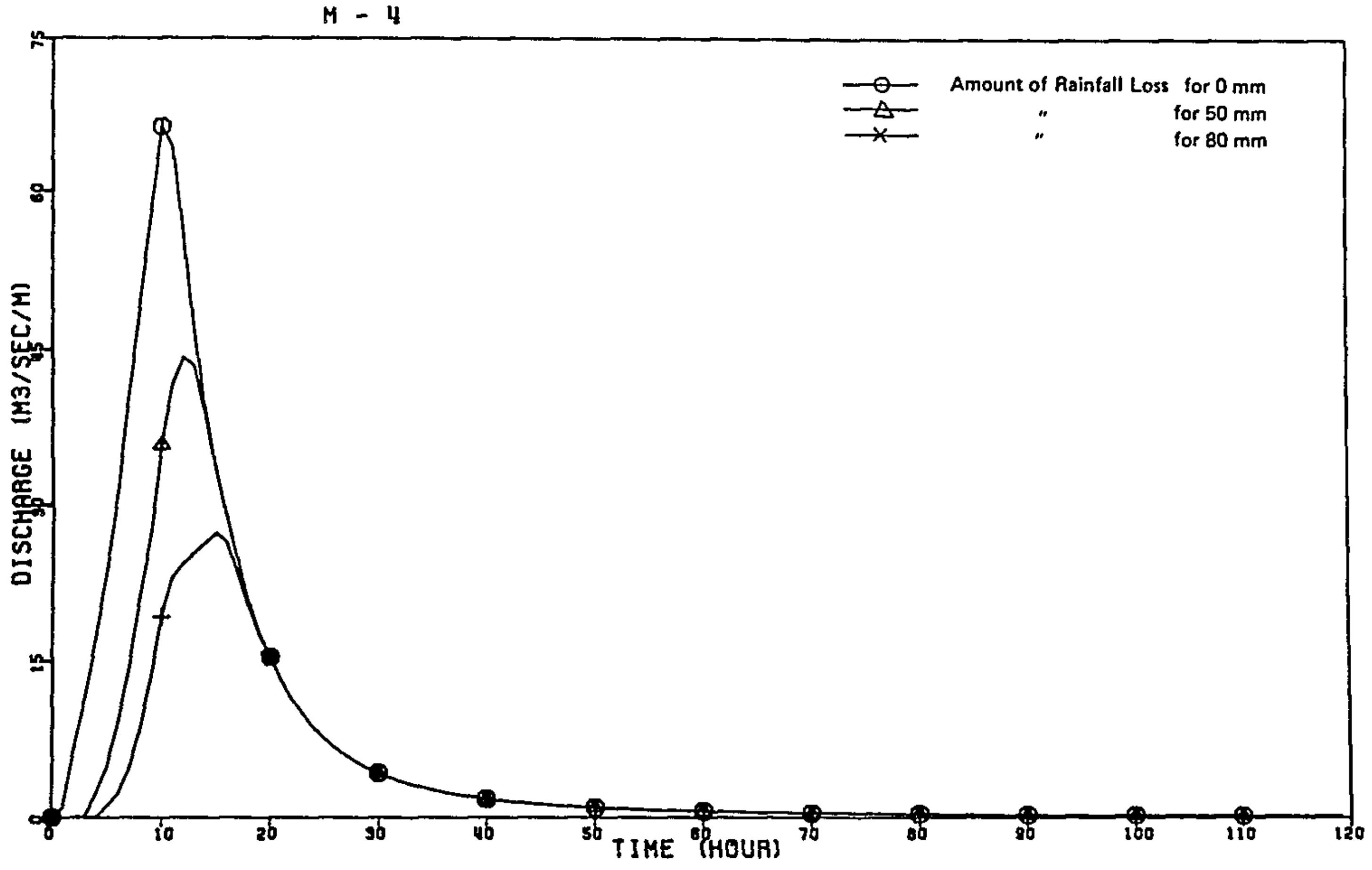


Fig. 3-10 Runoff Discharge Curve Based on the Characteristic Curve Method

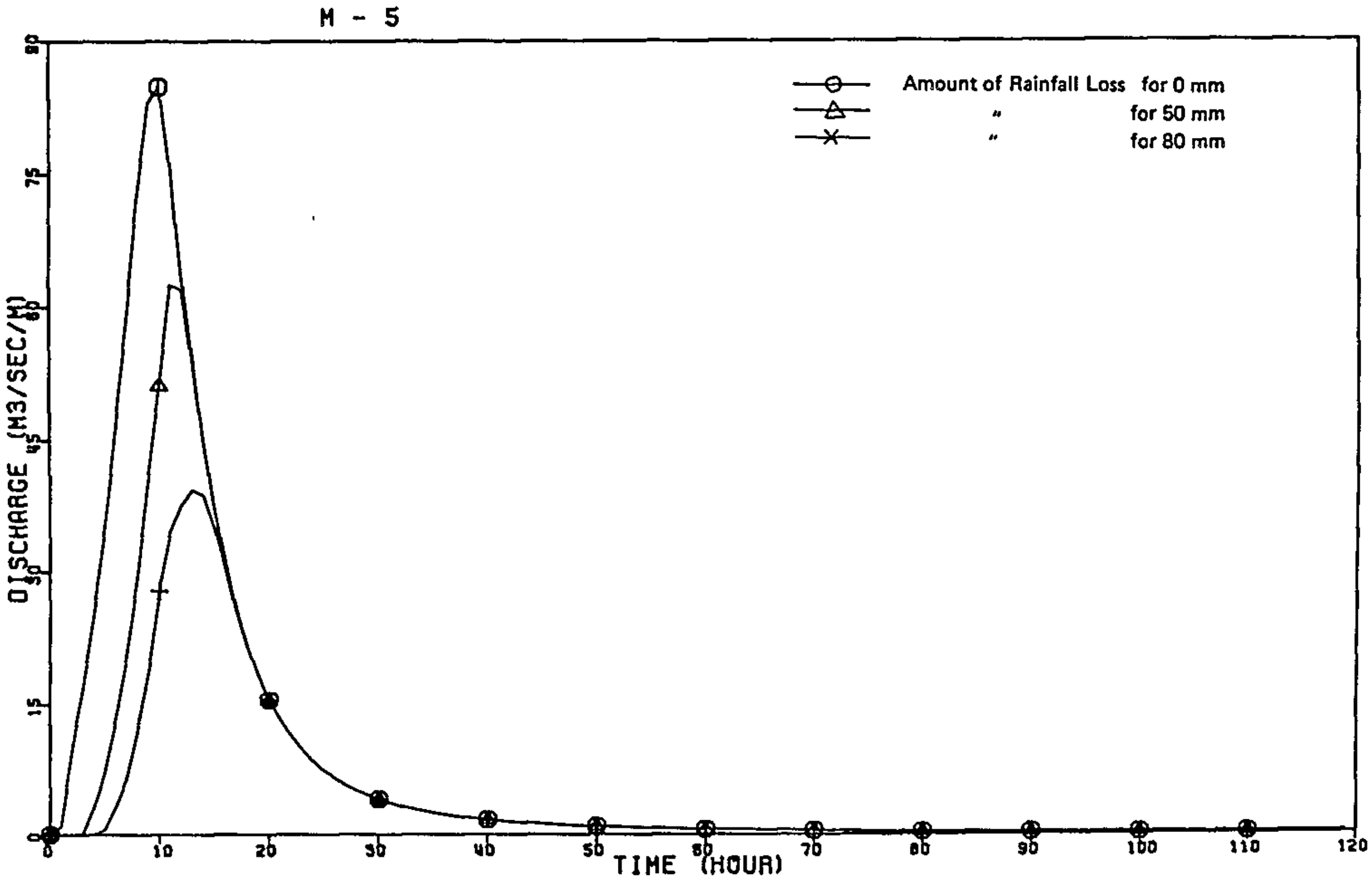


Fig. 3-11 Runoff Discharge Curve Based on the Characteristic Curve Method

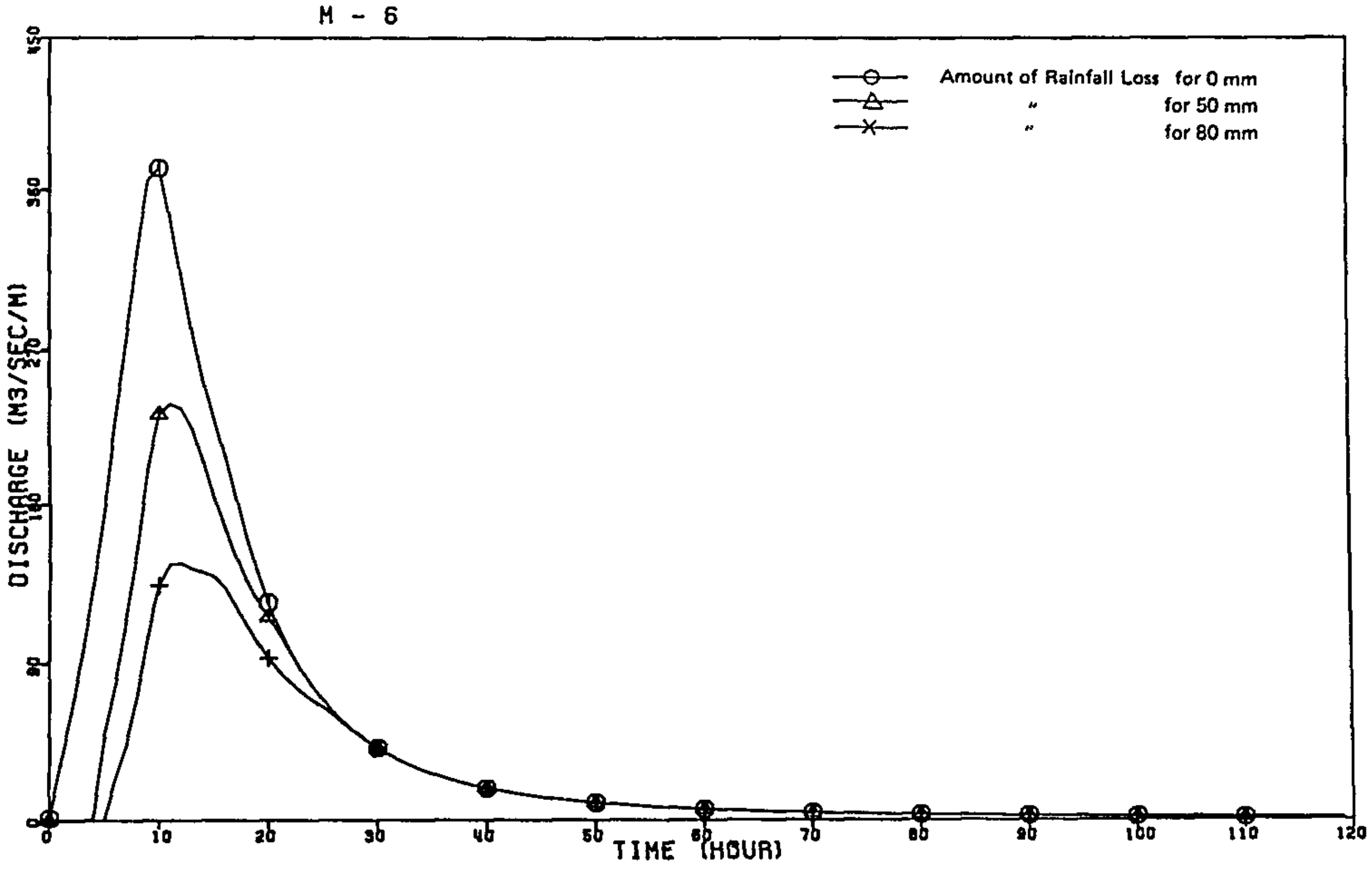


Fig. 3-12 Runoff Discharge Curve Based on the Characteristic Curve Method

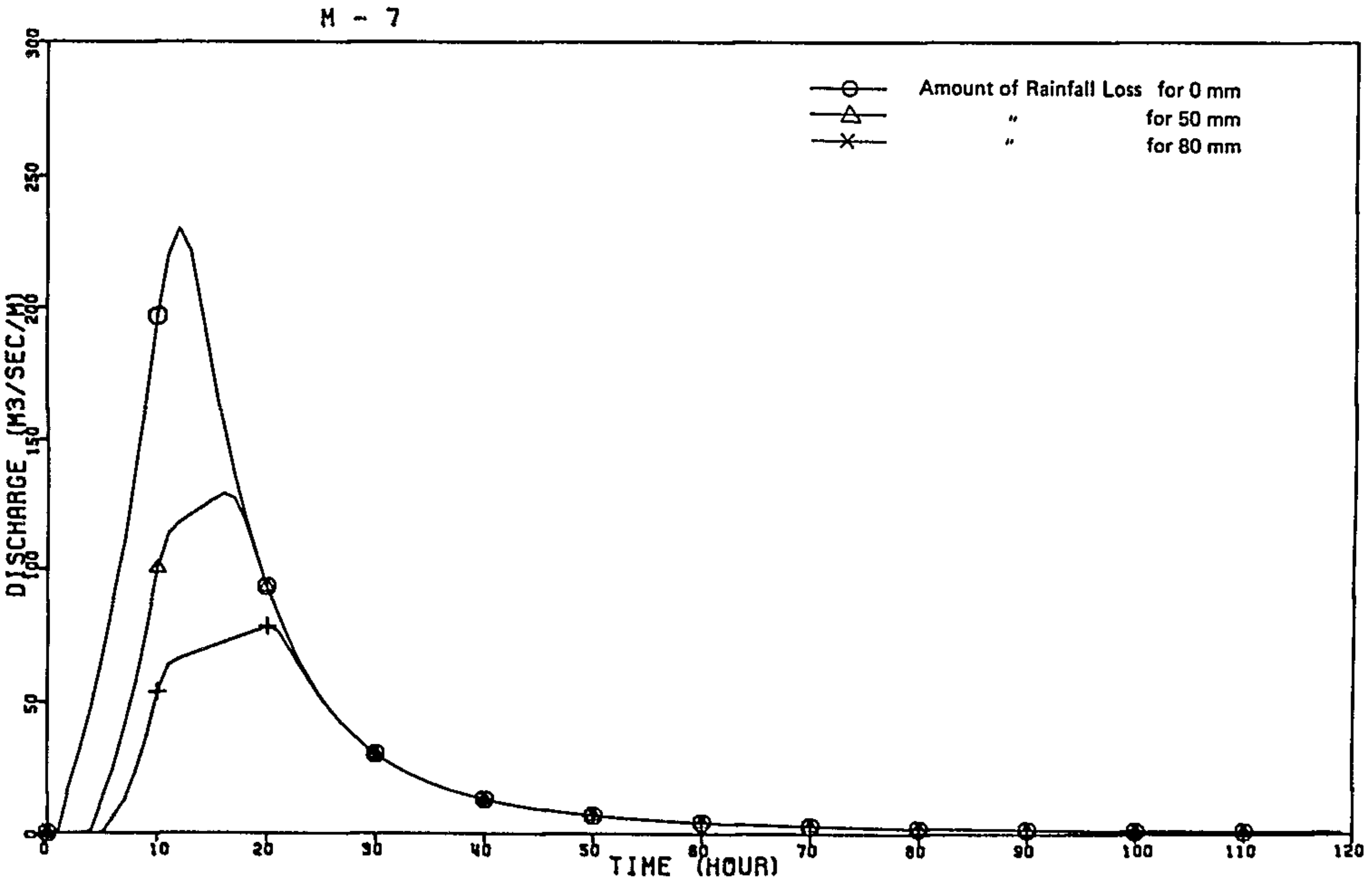


Fig. 3-13 Runoff Discharge Curve Based on the Characteristic Curve Method

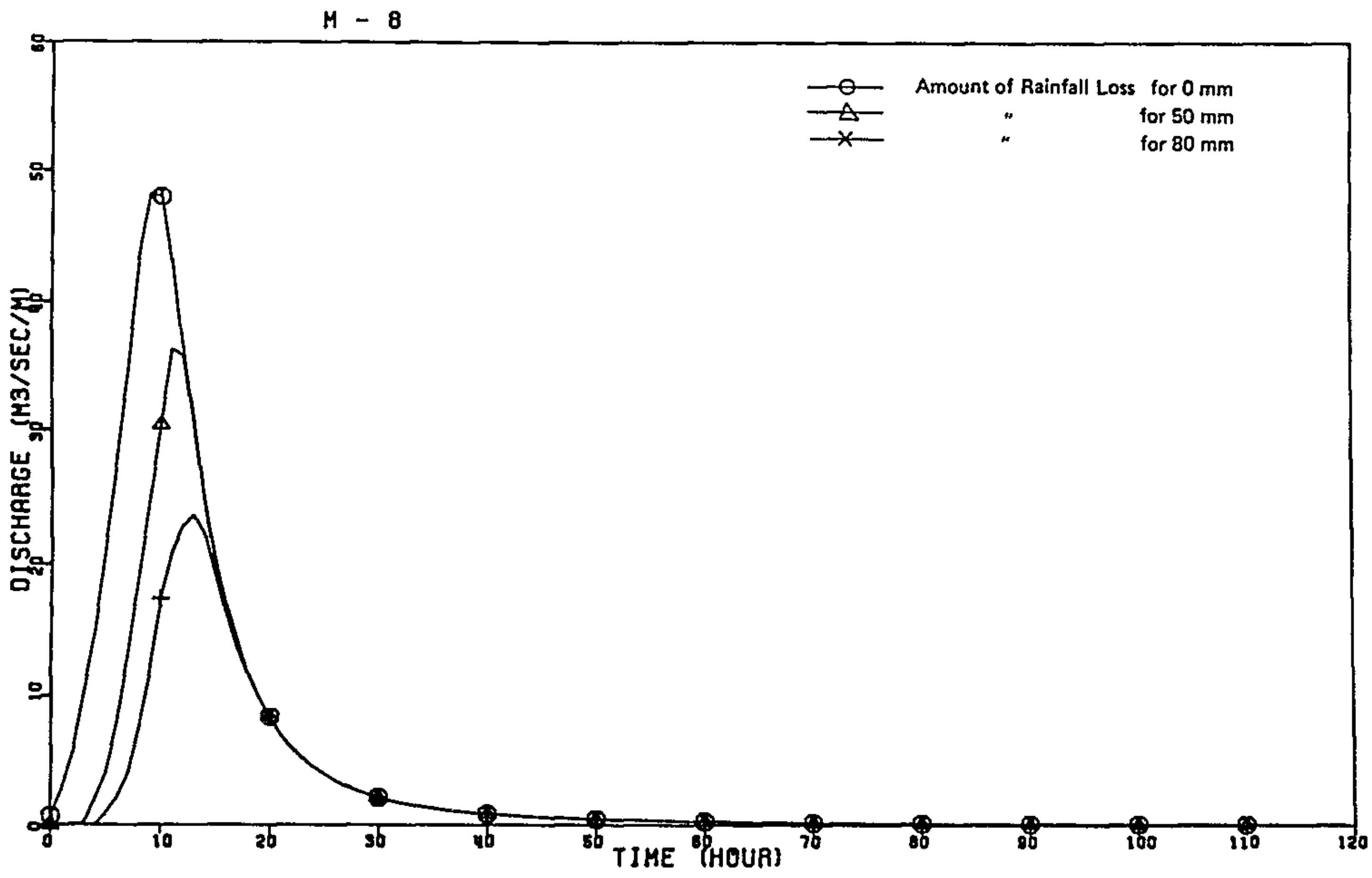


Fig. 3-14 Runoff Discharge Curve Based on the Characteristic Curve Method

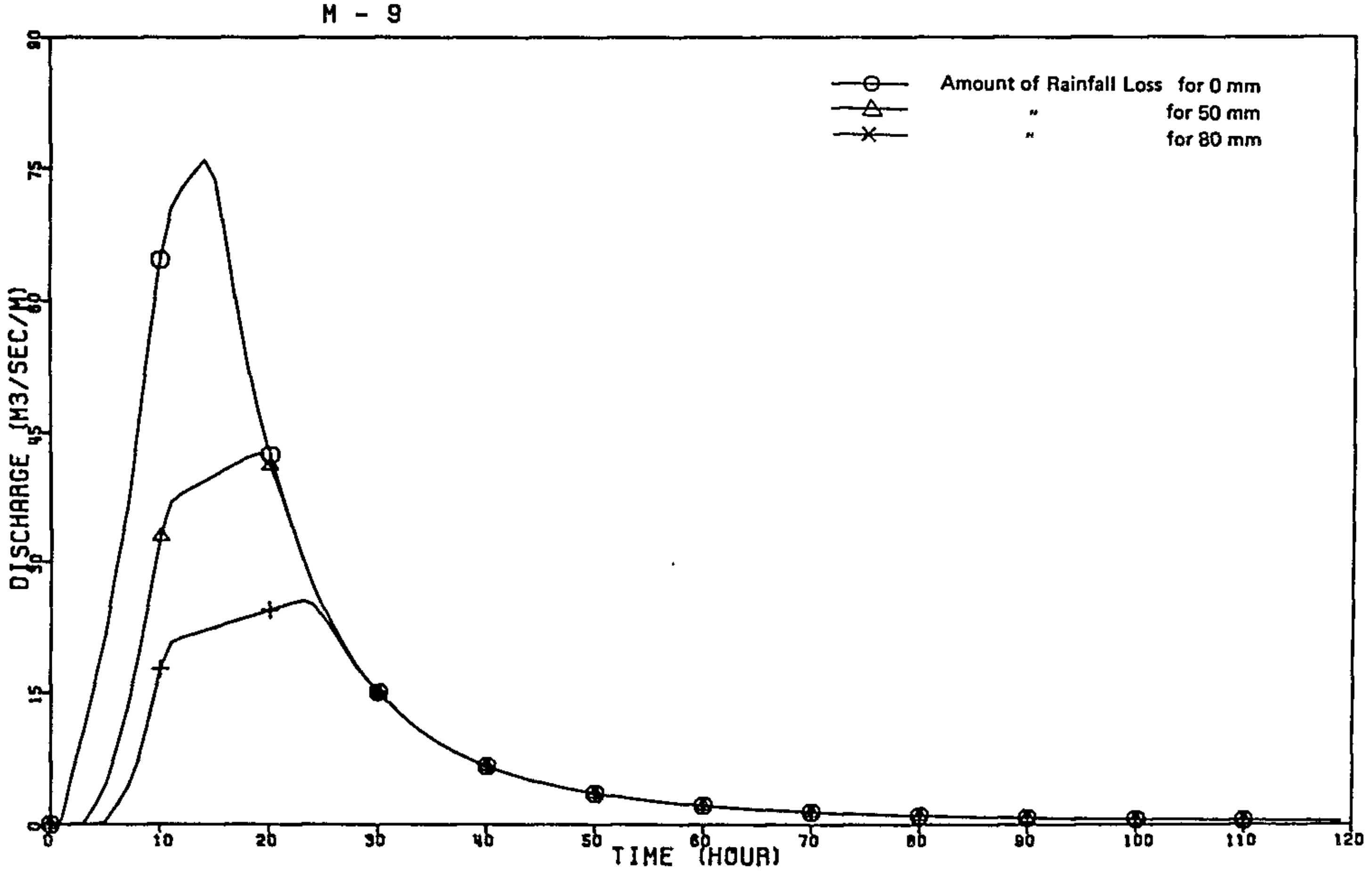


Fig. 3-15 Runoff Discharge Curve Based on the Characteristic Curve Method

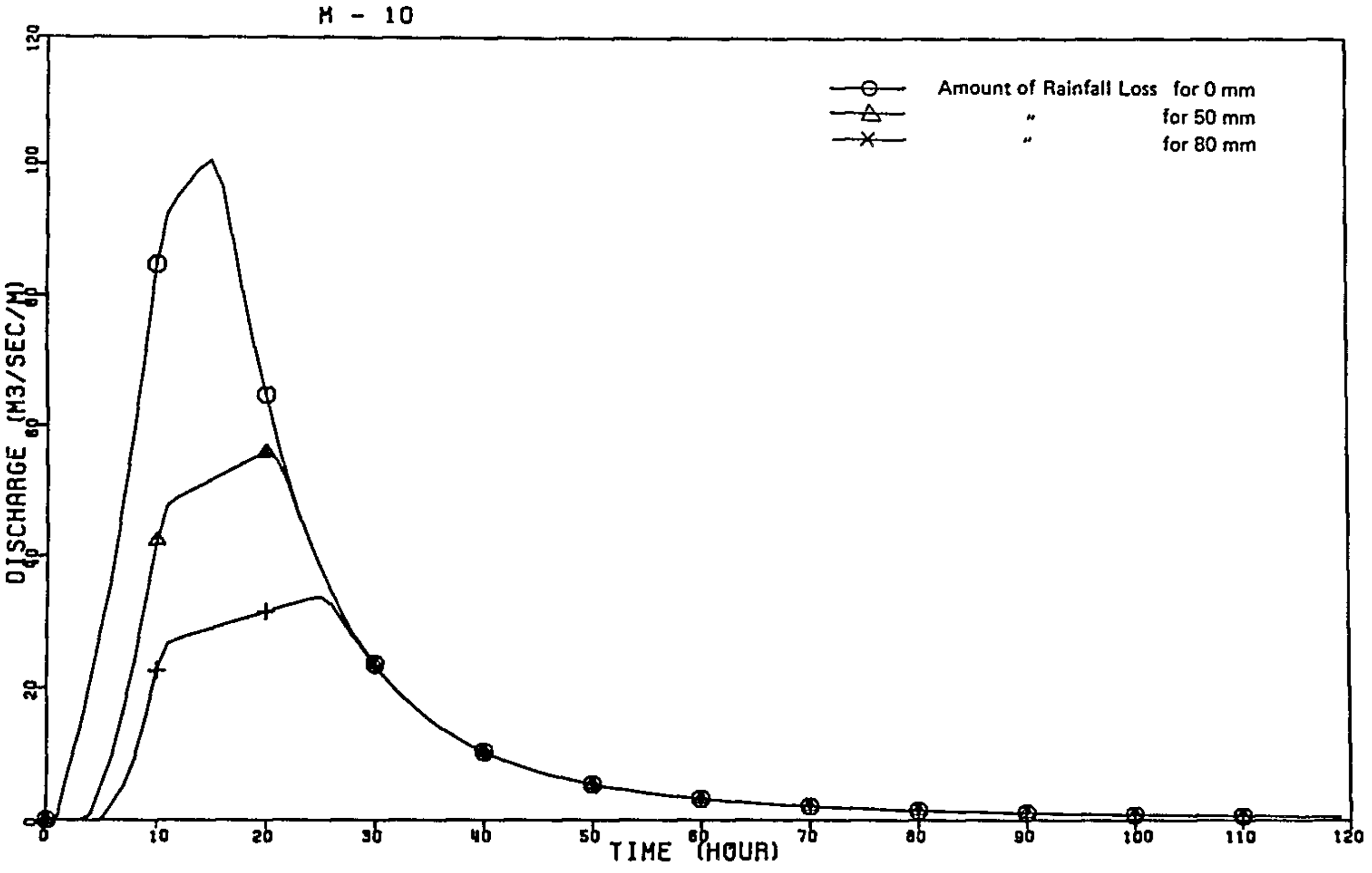


Fig. 3-16 Runoff Discharge Curve Based on the Characteristic Curve Method

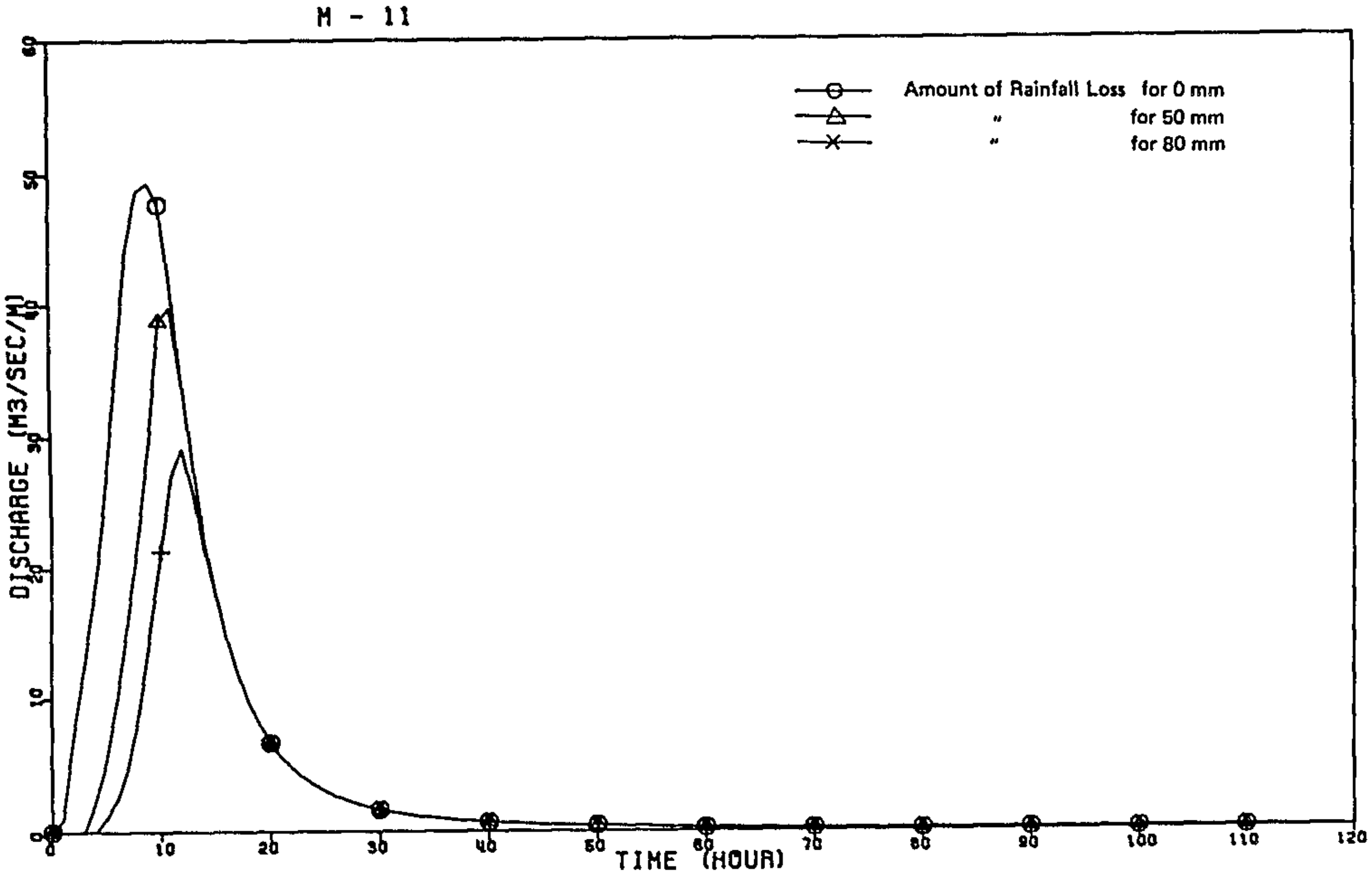


Fig. 3-17 Runoff Discharge Curve Based on the Characteristic Curve Method

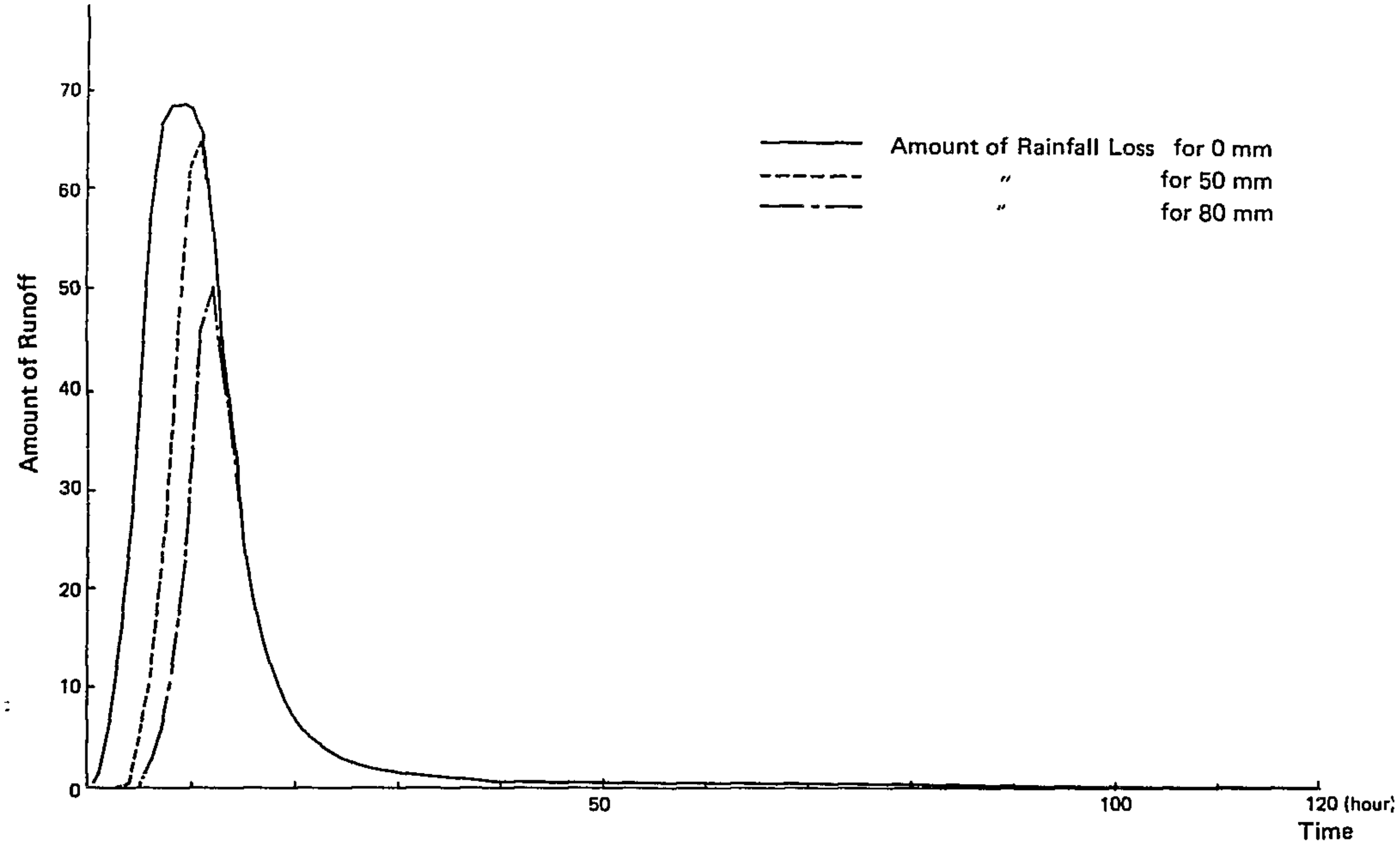


Fig. 3-18 Runoff Discharge Curve Based on the Characteristic Curve Method

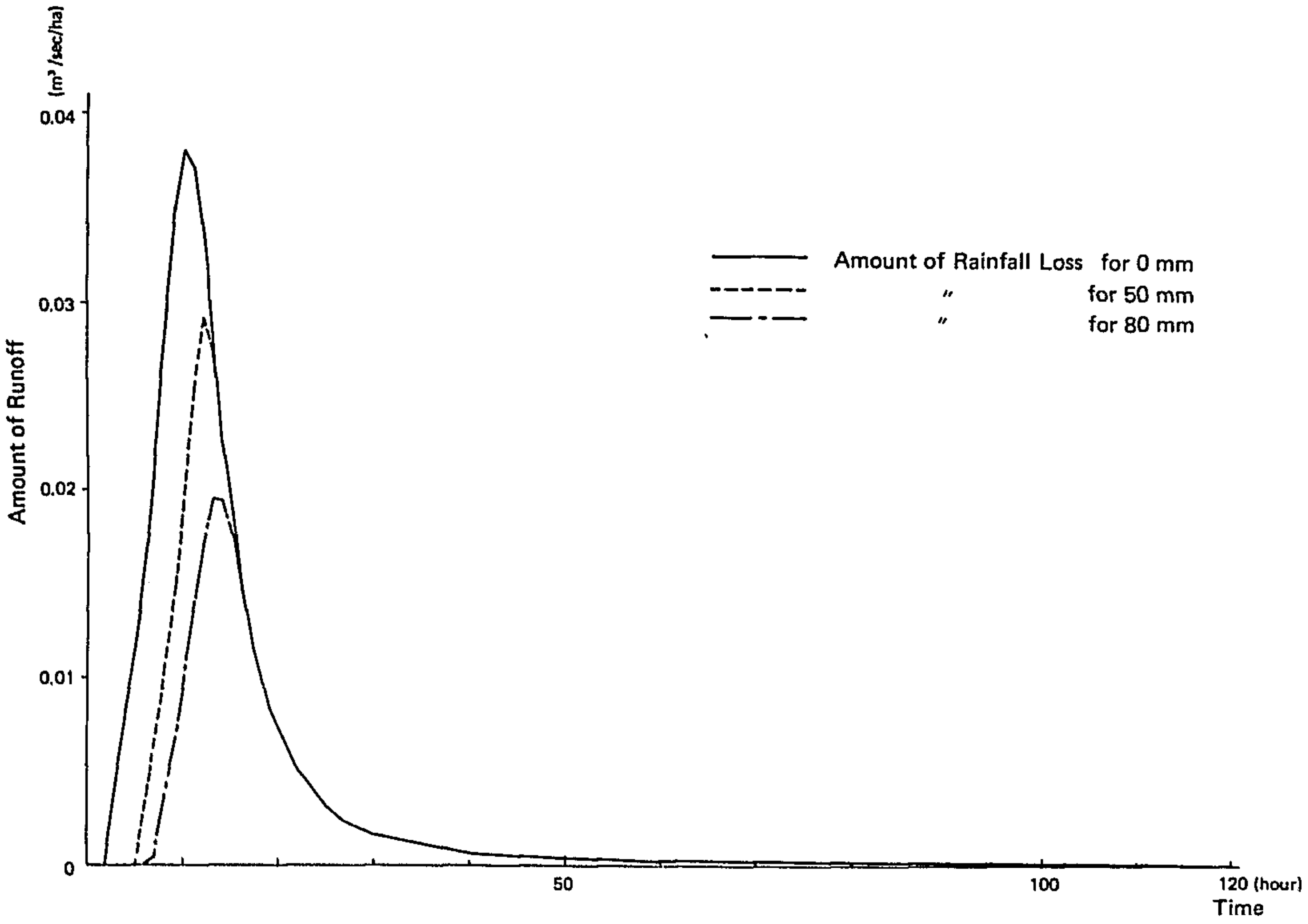
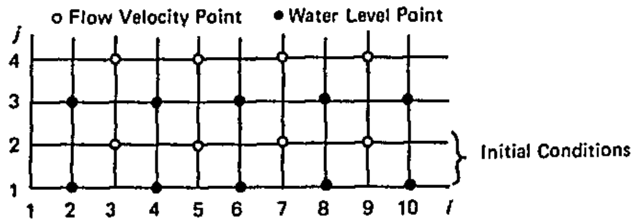
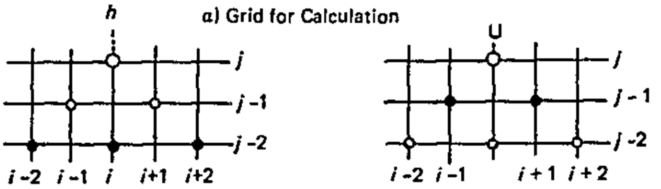


Fig. 3-19 Runoff Discharge Curve Based on the Characteristic Curve Method



a) Grid for Calculation



b) Continuous Equation Interesection Points c) Interlocking Equation Grid Points

Fig. 4-1 Explanation of the Calculation Processes

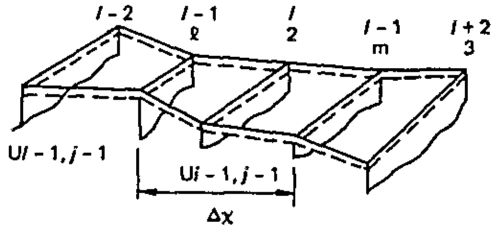


Fig. 4-2 Explanation of Averaging the River Regime

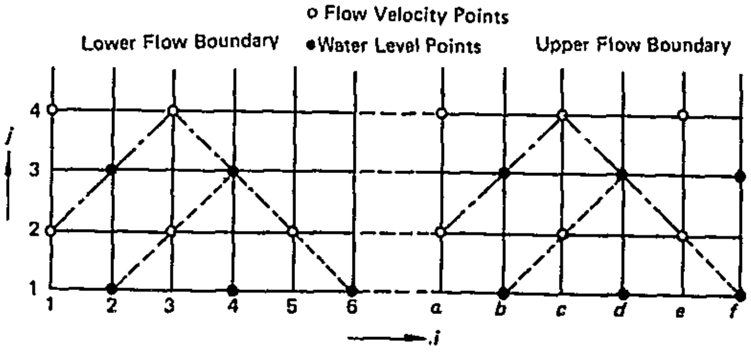
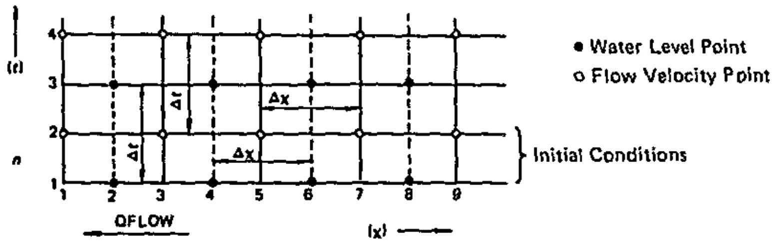


Fig. 4-3 Boundary Conditions



Grid for Calculation

Fig. 4-4 Grid for Calculation

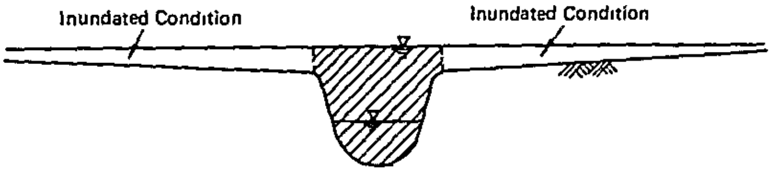


Fig. 4-5 Analysis of the Inundated Condition

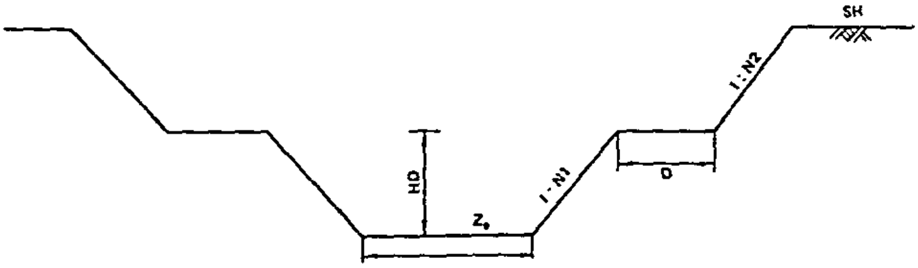


Fig. 4-6 Illustrated Cross-Section of the Drainage Canal

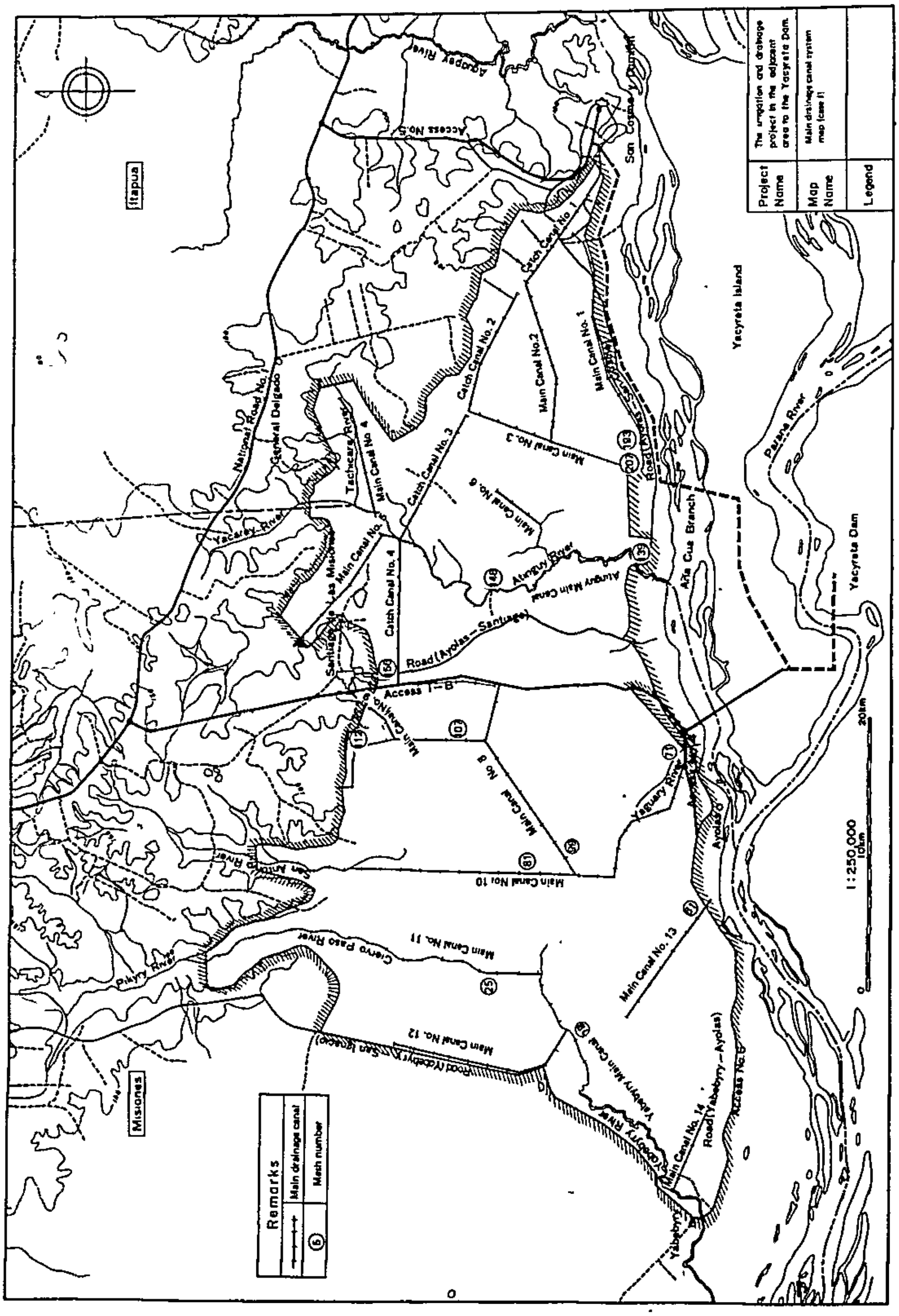


Fig. 4-7 Drainage System (System I)

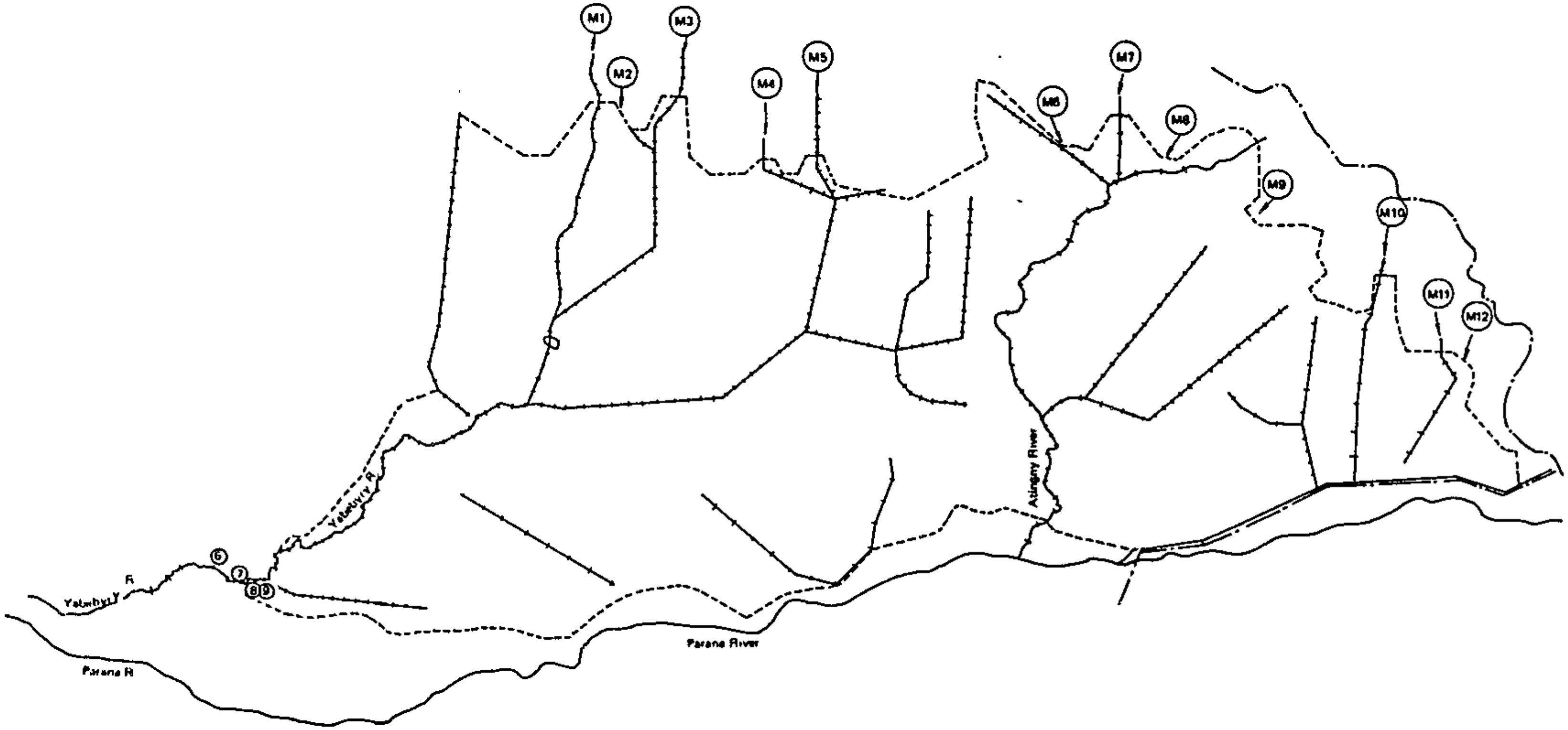


Fig. 4-8 Drainage System (System II)

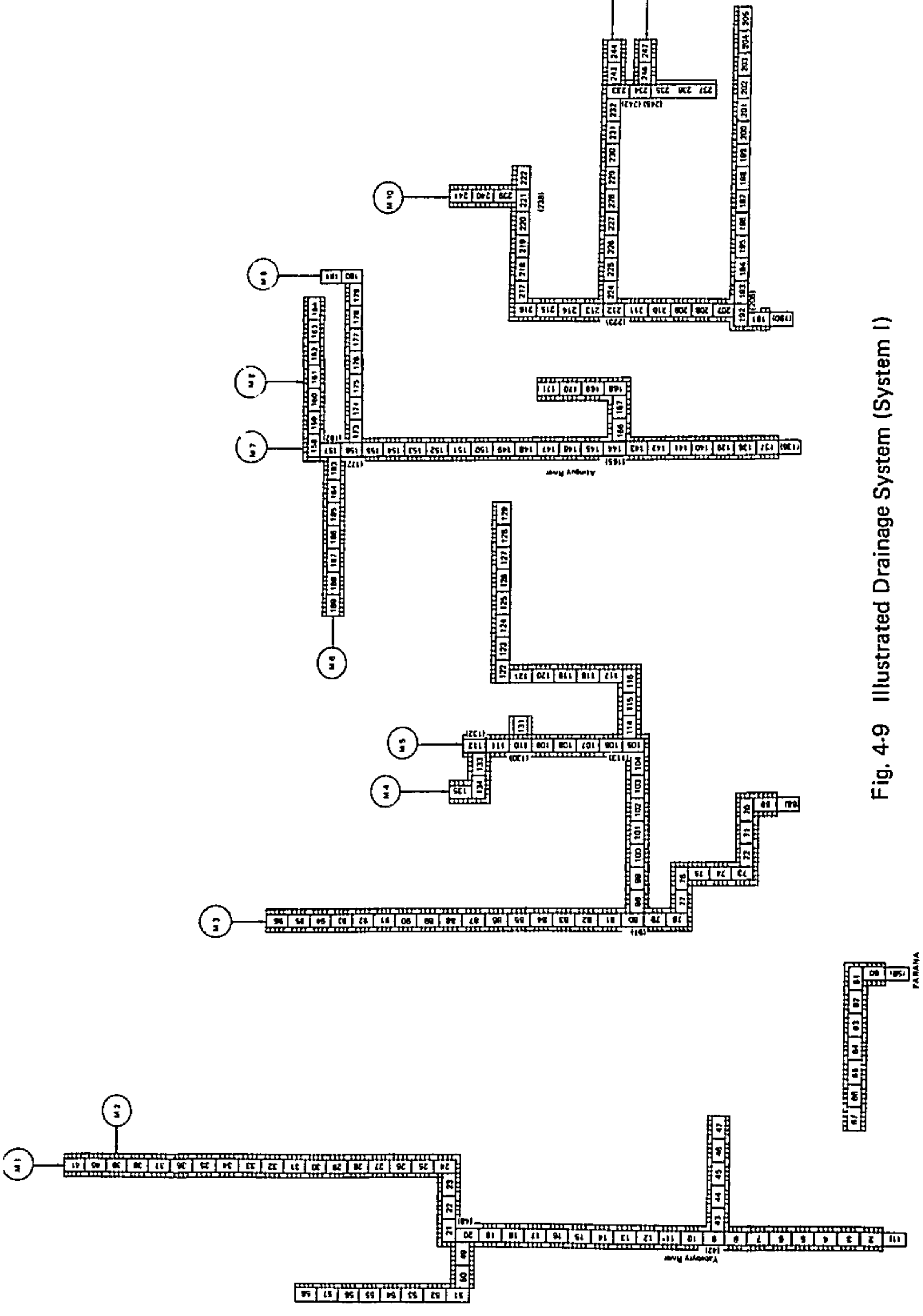


Fig. 4-9 Illustrated Drainage System (System I)

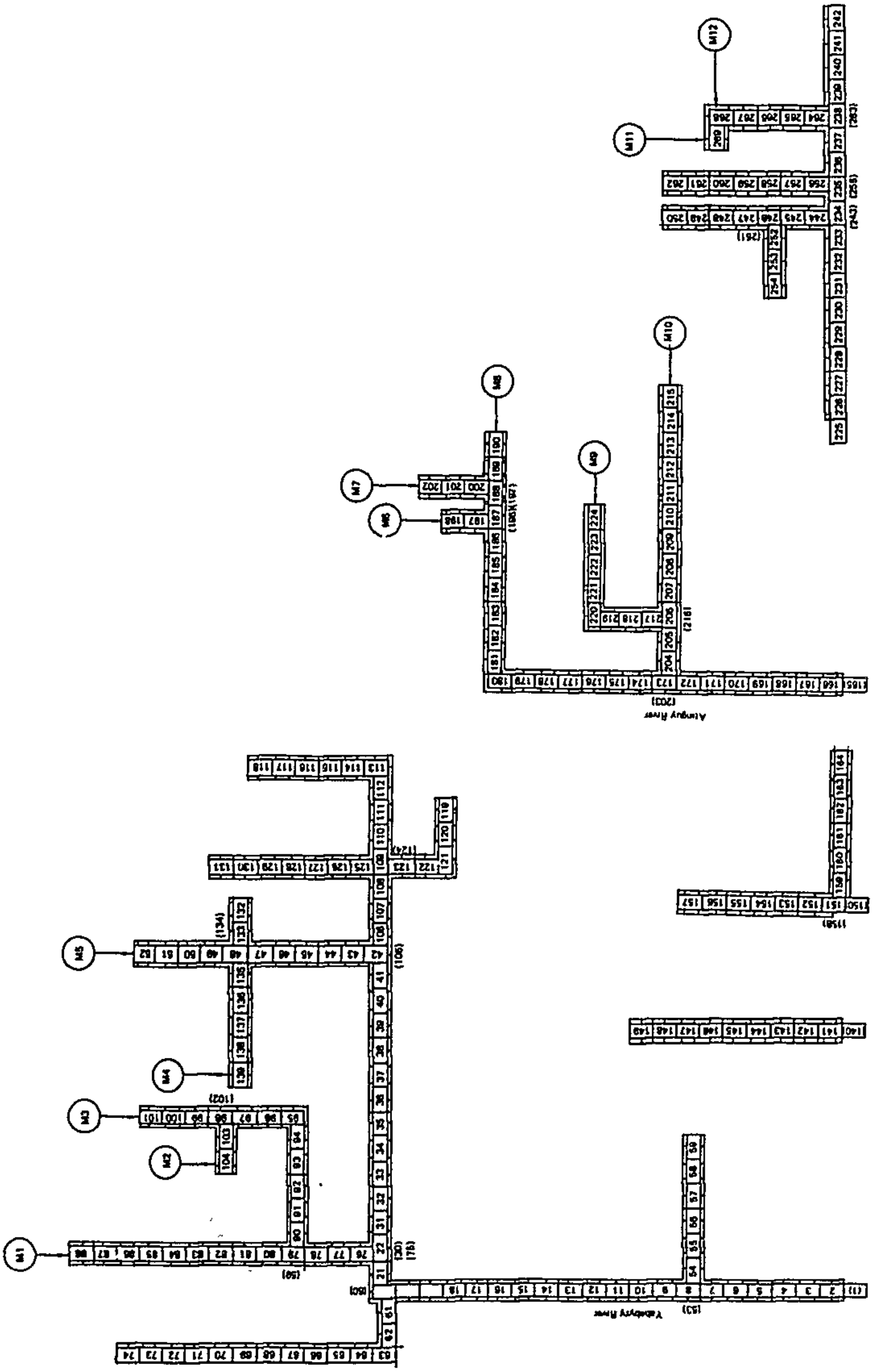


Fig. 4-10 Illustrated Drainage System (System II-1)

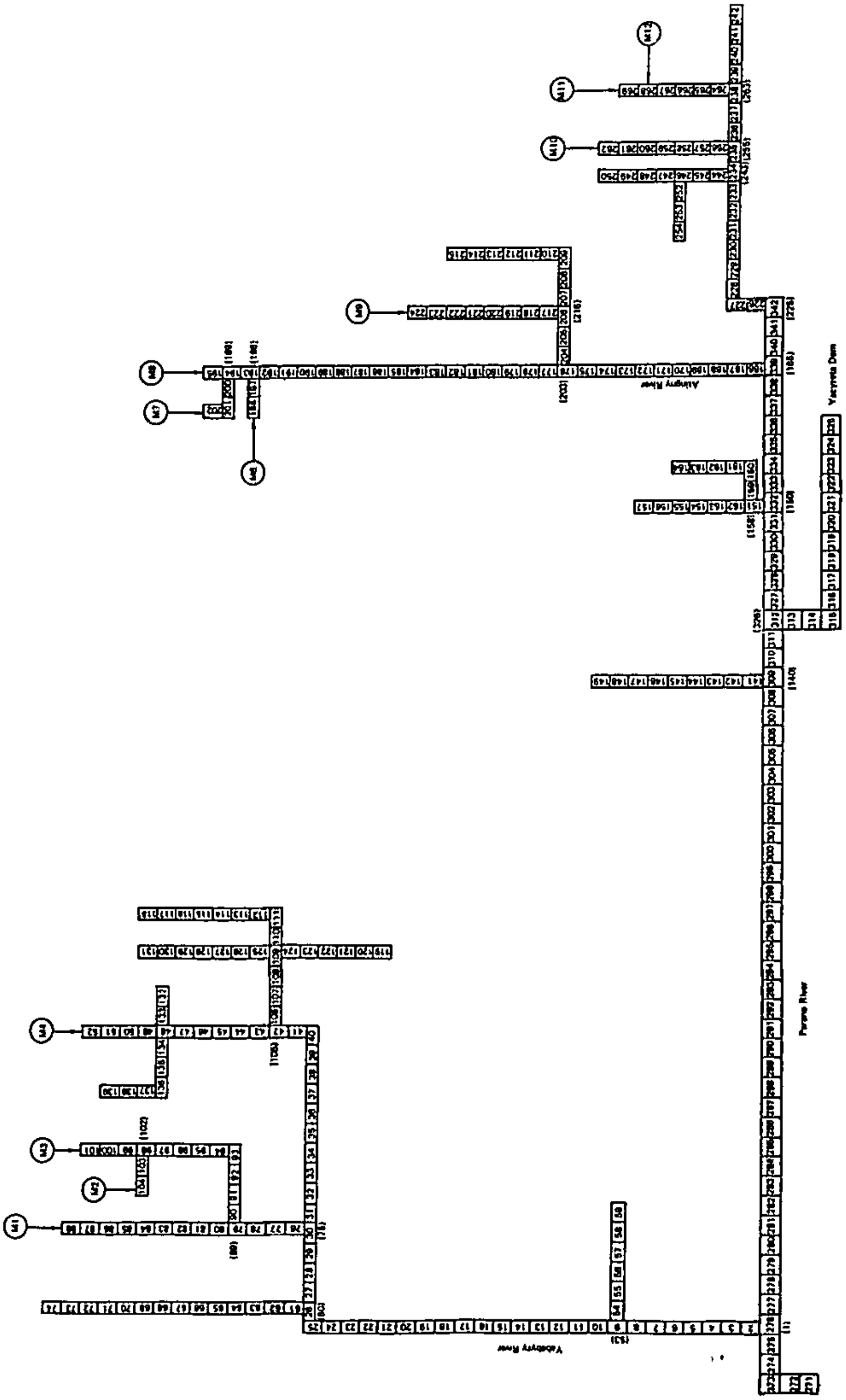


Fig. 4-11 Illustrated Drainage System (System II-2)