THE REPUBLIC OF VENEZUELA

STUDY ON CHAMA RIVER BASIN CONSERVATION PROJECT

AND

STUDY ON COMPREHENSIVE IMPROVEMENT OF THE APURE RIVER BASIN

USER'S MANUAL

FOR

COMPUTER PROGRAM

MARCH 1996

JAPAN INTERNATIONAL COOPERATION AGENCY

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CALCULO DE PRODUCCION Y
BALANCE DE SEDIMENTO

FEBRAURY 1995

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2. SEDIMENT STUDY

2.1 General

The Chama River Basin is classified as "active" in terms of sedimentation, i.e., sediment production, transportation and deposition is continuous throughout the year, unlike in "non-active" basins which have only a big sediment discharge when an extraordinary flood occurs. Therefore, sediment discharge has to be calculated on the yearly basis for the formulation of the sediment control plan.

Sediment discharges were estimated for the formulation of the sediment control plan. The study was carried out, firstly, to estimate the sediment production volume and sediment discharge in a river channel by applying the most suitable formula, and secondly, to prepare the sediment balance model of the basin for the computation of design sediment discharge at the reference point, namely El Vigía.

2.2 Production

Production Type

In view of the results of field investigation on topography, geology, soil and meteorology, sediment production in the Chama River Basin is believed to be brought from three causes; namely, (1) slope erosion in denuded areas, (2) slope failure at mountain slopes, and (3) torrent erosion in steep streams.

Denuded slopes are mainly observed in the semi-arid area in the middle reaches of the Chama River and the Nuestra Señora River Basin where rainfall is only around 600 mm per annum. Due to the scarce rainfall, slope erosions appear as gully erosions rather than sheet erosions.

Slope failures are mainly observed in hilly areas formed with weathered rocks of the Tertiary, Mesozoic and Paleozoic layers. Failures are estimated at approximately 2,000 m^2 in area and 20,000 m^3 in volume, except the landslide in the upstream of the Desbarrancadero River, a tributary of La Mucuy River, which is estimated at 2,240 m^2 in area, 15 m in depth and 3,360,000 m^3 in volume.

Torrent erosion is predominantly observed along the Nuestra Señora River, the San Pablo River, La Vizcaína River, and their tributaries. Streams of more than second-order have been the sources of eroded sediment which is deposited in the stream bed. Major streams of more than fourth-order have bank side erosions. Rivers and streams in other basins are rather free from torrent erosion owing to the encroaching vegetation cover and armor coat formed on the riverbed.

Production Volume

In accordance with the above classification of sediment production, production volume was calculated by employing the most suitable equation in consideration of the following conditions:

- Volume of production, discharge and transportation of sediment shall be estimated for daily rainfall and flow discharge in terms of cubic meter per annum (m^3/year).

- Volume at each reference point and at each sub-basin shall both be calculated; topographical and geological conditions of each sub-basin shall be reflected in calculations.

In view of the above considerations, the following formulas were adopted for the calculation of sediment production volume:

(1) Slope Erosion

The following formula developed by S. Kohmura for large river basins has been adopted:

$$E_V = \frac{476\ C_a C_e}{d} q^{15/8} \cdot L^{3/8} \cdot So^{3/2}$$

where, the inflow discharge on a slope, q is expressed as follows:

$$q = 2.778 \times 10^{-7} \cdot f \cdot i$$

E_V : eroded sediment volume ($m^3/s/m^2$)
C_a : areal ratio of denuded land

C_e : erodability coefficient
f : runoff coefficient
i : rainfall intensity (mm/hr)
L : slope length (m)
d : mean size of sediment particle (mm)
So : slope gradient

Furthermore, the erodability coefficient Ce is expressed by the following equation:

$$Ce = 0.17Cm \frac{(1 + 3.67Rd)}{(Cr/Dr)} : Cr/Dr > 0.0425$$

$$Ce = 4Cm (1 + 3.67Rd) : Cr/Dr \leqq 0.0425$$

where,

Cm : compaction efficiency of soil
cultivated area Cm = 1.5
compacted soil Cm = 1.0
cut slope soil Cm = 0.5
Cr = Clay(%) / [Sand(%) + Silt(%)]
Dr = Suspension(%)/[Silt(%) + Clay(%)]
Rd = nBr/B : density of gully

where, B : slope width
Br : width of gully
n : number of gullies in the slope width of B

The parameters and variables which were used in the computation for each sub-basin are given in Table VI-13.

(2) Slope Failure

The following formula was developed by Uchiogi through the continuous observation of slope failures in Japan. The volume of slope failure C_v is expressed as follows:

$$C_v = D \cdot K \cdot A (\sum r - r_n)^2$$

where,

C_V : volume of slope failure (m^3)
D : average failure depth (m)
K : coefficient
r_n : failure non-effective rainfall (mm)
A : basin area (m^2)
$\sum r$: cumulative rainfall (mm)

Density, length, width and depth of the existing slope failures were extracted from the aerophoto taken in 1989 and presented in Table VI-14.

The slope failure depth D was determined at 2 m at minimum as well as 10 m for La Mucuy River Basin and 5 m for the devastated tributary basins on the basis of the data obtained from the sampling survey and aerophotos. The coefficient K was derived from the study results conducted in Japan, which was set at 4.0×10^{-6}.

(3) Torrent Erosion

Torrent erosion is caused by tractive force of water flow. Brown's formula as given below has been applied for calculation of the volume of bed load in torrents.

$$q_b / U^* d = 10[U^{*2} / (\sigma/\rho) g d]^2$$

where,

q_b : bed load ($cm^3/s/cm$)
U^* : critical tractive force
d : mean diameter of bed load particle (cm)
σ : unit weight of sediment (g/cm^3)
ρ : unit weight of flowing water (g/cm^3)
g : gravity acceleration (cm/s^2)

Converting the formula for a torrent with a width of B, torrent erosion volume is expressed as below:

$$Q_b = \frac{1.925 \times 10^3}{d} \left[\frac{nQ}{B} \right]^{3/2} \cdot i^{7/4} \cdot B$$

where,

Q_b	:	torrent erosion volume (m^3/s)
B	:	torrent width (m)
i	:	gradient of torrent bed
n	:	Manning's roughness coefficient
Q	:	flow discharge (m^3/s)

In this formula, the torrent width (B) was computed by using the Regime Theory as expressed below:

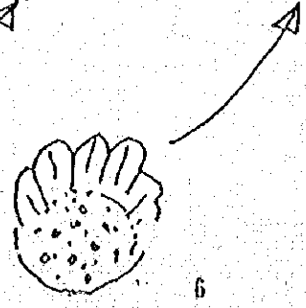
$$B = \alpha Q^{1/2}$$

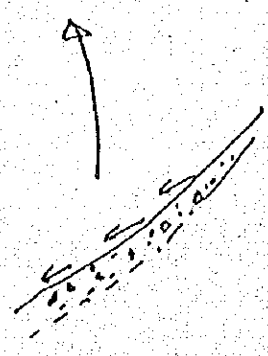
where,

B	:	torrent width (m)
Q	:	flow discharge (m^3/s)
α	:	constant (= 2.0)

The other parameters used for the calculation are given in Table VI-15.

By using the data in the said tables as parameters of the equations, annual sediment production were estimated for 21 years from 1967 to 1987 as shown in Table VI-16. The average annual sediment production volume was estimated at 25,560,000 m^3, consisting of 5,240,000 m^3 coarse material load and 20,320,000 m^3 fine material load. The coarse sediment produced by slope erosion, slope failure and torrent were estimated at 2,775,000 m^3, 55,000 m^3 and 2,410,000 m^3, respectively.





2.3 Transport and Balance

Sediment discharge is defined as the quantity of sediment per unit time carried across any cross section of a stream, therefore, it is mostly considered to be similar to water discharge in movement. However, the sediment is very different from water from the following aspects.

- Sediment cannot flow by itself without any external force such as liquid or gas.
- Such an external force must be of a certain strength to move sediment, which is called the critical force that vary according to the size of sediment.
- Due to the above characteristics, sediment show a discontinuous motion; flowing down or staying in a stream or a slope.

In the Chama River Basin, the sediment produced in the upstream area is carried down finally to the Maracaibo Lake. This is the principal movement of all sediment in the basin. However, as discussed in Subsection 2.3, the sediment from sub-basins is sometimes deposited in the middle reaches of the Chama River and transported to the downstream area with floods.

In the alluvial fan or the floodplain, the sediment may spread out and be deposited with a big flood, and the deposited sediment will not reach the lake for a long time. Therefore, it is necessary to conduct a study on sediment transport and balance along the Chama mainstream and major tributaries to understand the sediment movement in the basin.

A model sediment transport and balance was constructed to estimate sediment transport at the major points and balance among the said points. In the model, all the sediment discharge, transport and balance were measured in a unit of m^3/year. The general procedure used in the study is shown in Fig. VI-17.

Sediment Transport Model

The base points for the calculation of sediment volume were selected along the Chama River and major tributaries, taking into account the requirement of the formulation of the sediment control plan. In the selection of base points, the following locations were considered. As done for the flood runoff analysis, 33 sites were selected as presented in Table VI-17.

- Confluence point of major tributaries to the Chama River;
- Downstream point of mainstream section between the confluence points of tributaries; and
- Promising site of sediment control facilities in the Chama River.

The Chama River Basin was divided into 21 sub-basins and 12 channel sections, as shown in Fig. VI-18. The area of sub-basins are given in Table VI-18, and the lengths and widths of the divided channel sections are shown in Table VI-19. From this basin division, the model diagram of sediment transport and balance in the Chama River Basin was constructed as presented in Fig. VI-19.

Sediment Discharge

Sediment rating curves showing the relationship between river discharge and volume of riverbed materials to be transported in the river channel were constructed at the base points on the basis of the grain size distribution given by the riverbed materials survey. As a sediment transport formula to estimate the bed load under the present river condition, the Ashida, Takahashi and Mizuyama's Formula was employed. This formula is widely applied for the estimation of bed load in mountain rivers with steep riverbed slope and wide distribution of riverbed materials, and it is expressed by the following equation:

$$\frac{Qb}{\sqrt{(\sigma/\rho - 1)\ gdm^3}}$$

$$= \frac{12 + 24 \cdot \sqrt{\tan\theta}}{\cos} \cdot \gamma^{2/3} \sqrt{\tan\theta} \cdot (1 - \gamma^2 \frac{Uc^{*2}}{U^{*2}}) \cdot (1 - \gamma^2 \frac{Uc^*}{U^*})$$

where,

- Qb : sediment discharge per river width ($cm^3/s/cm$)
- U* : friction velocity (cm/s)
- Uc* : critical friction velocity (cm/s)
- γ* : non-dimensional tractive force
- θ : riverbed gradient
- dm : mean diameter of bed materials (cm)
- σ : specific weight of bed materials (= 2.65 g/cm^3)
- ρ : water densityof water (= 1.0 g/cm^3)
- g : acceleration of gravity (= 980 cm/s^2)

$$\alpha = \left[\frac{2 \{ \mu f - (\sigma/\rho) / (\sigma/\rho - 1) \cdot \tan\theta \}}{1 - (\sigma/\rho / (\sigma/\rho - 1) \cdot \tan\theta} \right]^{1/2}$$

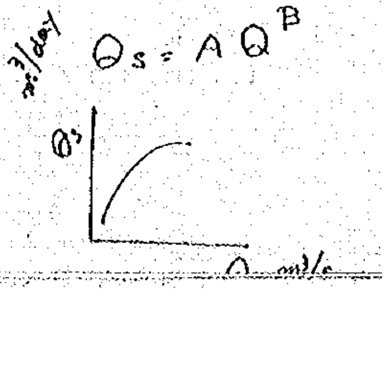
- μf : friction coefficient of sediment (= 0.425)

The transport volumes of riverbed materials at base points were calculated by the above formula under the present river condition. Manning's roughness coefficient and the riverbed gradient are given in Table VI-20.

In this calculation, the grain size distribution of riverbed materials are divided into eight ranges as given in Table VI-21. Sediment discharge is estimated for each range of grain size and the total transport volume of riverbed materials at base points is estimated by summing up the respective volumes of grain sizes.

The obtained rating curves at several base points are presented in Fig. VI-20. In addition, the determined constants of rating curves by base point are shown in Table VI-22.

ASHIDA, BAS →



Critical Discharge

As described in Subsection 2.2.2, an armor coat has been formed over the riverbed of the Chama River and major tributaries. The riverbed materials covered by the armor coat are not transported unless the armor coat is removed and washed out by a big flood.

In general, a force of flowing water known as the tractive force is developed and acts on the riverbed in the flow direction. This tractive force becomes stronger as the river discharge increases; thus, the armor coat is forced to moved when the tractive force becomes higher than the friction force of the armor coat materials. At this condition, the tractive force is known as the critical tractive force.

The discharge that will cause the armor coat materials to move is called the critical discharge. The critical discharges were estimated at the respective base points by the following procedures.

(1) Estimation of Critical Tractive Force

Critical tractive force is expressed by the following equation:

$$Yc^* = \frac{Uc^{*2}}{(\sigma/\rho - 1) \cdot g \cdot dm}$$

where,

- Y^*c : critical tractive force (non-dimensional)
- Uc^* : critical friction velocity (cm/s)
- σ : specific weight of bed materials (= 2.65 g/cm^3)
- ρ : water density of water (= 1.0 g/cm^3)
- g : acceleration of gravity (= 980 cm/s^2)
- dm : mean diameter of materials in the armor coat (cm)

For the estimation of critical friction velocity, the Iwagaki's Formula was employed. This empirical formula is expressed as follows:

$0.303 \text{ cm} < d$	: $U^*c^2 = 80.9\, d$
$0.118 \text{ cm} < d < 0.303 \text{ cm}$	: $U^*c^2 = 134.6\, d^{31/22}$

0.0565 cm < d < 0.118 cm	: $U_{*c}^2 = 55.0\ d$
0.0065 cm < d < 0.0565 cm	: $U_{*c}^2 = 8.41\ d^{11/32}$
d < 0.0065 cm	: $U_{*c}^2 = 226\ d$

where, U_{*c} is the critical friction velocity (cm/s)

The relation between the critical tractive force and the particle size of materials is shown in Fig. VI-21.

(2) Calculation of Critical Water Depth

The critical water depth of the river channel is estimated in terms of friction velocity, riverbed slope and acceleration of gravity as given below:

$$U_{c*} = \sqrt{g \cdot h_c \cdot I}$$

where,

U_{c*} : critical friction velocity (cm/s)
g : acceleration of gravity (= 980 cm/s^2)
h_c : water depth (cm)
I : riverbed slope

With the above equation, the water depth for the critical discharge is estimated as shown below:

$$h_c = \frac{U_{c*}^2}{g \cdot I}$$

(3) Calculation of Hydraulic Values

The Chama River has steep riverbed gradients of more than 1/100 at all the base points. The hydraulic calculation was therefore made by applying the uniform flow condition.

The following Manning's uniform flow formula is applied:

$$V = \frac{1}{n} \cdot R^{2/3} \cdot I^{1/2}$$

where,

V : mean velocity (m/s)
n : roughness coefficient
R : hydraulic radius (m)
I : riverbed slope

The empirical Regime Theory representing the relation between the river discharge and flow width is applied at the base points where no river cross section data is available. The said relation is expressed as follows:

$$B = 2\,Q^{1/2}$$

where,

B : flow width (m)
Q : river discharge (m^3/s)

(4) Estimation of Critical Discharge

By using the two equations introduced in (2) above, the critical discharge is calculated as follows:

$$Qc = A \cdot V$$

$$= \frac{1}{n} \cdot B \cdot hc^{5/3} \cdot I^{1/2}$$

where, A : flow area; $A = B \cdot hc$

In combination with flow depth (hc) introduced by the Regime Theory mentioned above, the critical discharge is finally calculated as presented below:

$$Qc = \left(\frac{5}{n} \cdot I^{1/2} \cdot hc^{5/3} \right)^2$$

where,

Qc	:	critical discharge (m^3/s)
n	:	roughness coefficient
I	:	riverbed slope
hc	:	water depth (m)

Consequently the estimated critical discharges at the base points are summarized in Table VI-23.

Sediment Balance

Sediment balance calculation was carried out at 33 base points composed of 21 sub-basins and 12 channel sections to examine the movement of sediment under the existing river condition. With the daily discharges, sediment volumes of inflow, outflow and balance in both sub-basins and channel sections were calculated. The procedure for sediment balance calculation for each river channel is explained hereinafter.

(1) Sediment Inflow

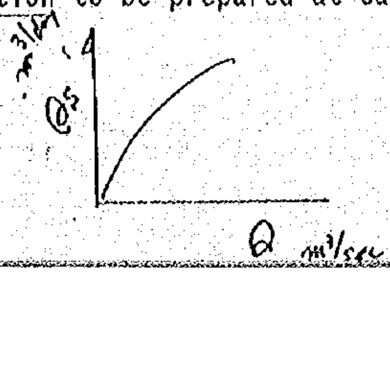
For sub-basins, sediment inflow is estimated based on the sediment production yield from the catchment as computed in Subsection 2.2. On the other hand, sediment inflows for channel sections, e.g., the Chama River and the Mocoties River, were calculated by the summation of the following:

- Sediment outflow from the upper river channel
- Sediment outflow from the tributary channel(s), if any.

(2) Sediment Outlow

Sediment outflows from sub-basins and channel sections are dominated by the sediment transport capacities characterized by the hydraulic conditions of the respective river channels such as river cross section, riverbed gradient and roughness coefficient, and grain size distribution of riverbed materials.

Sediment outflow was estimated by using the sediment rating curve and flood discharge distribution to be prepared at each base point.



(3) Sediment Balance NKASYO.FOR

Sediment balance is expressed as follows:

$$Sb = Si - So$$

where, Sb : sediment balance volume (m^3)

Si : sediment inflow volume (m^3)

So : sediment outflow volume (m^3)

If the sediment balance volume (Sb) is positive, the sediment is deposited in a sub-basin or a river channel, and if negative, erosion occurs.

(4) Condition of Balance Calculation

For the sediment balance calculation, two riverbed conditions, i.e., the fixed bed and the movable bed, are applied. In the case of the fixed bed channel, erosion does not occur. The river channels of No. 1, 2, 3, 9 and 10 and all sub-basins are assumed to be the fixed bed channel. The other river channels, e.g., No. 4, 5, 6, 7, 8, 9, 11 and 12 are considered to be of movable bed condition, where both erosion and deposition will take place.

Results of Calculation

The sediment discharges were estimated with the daily water discharge for the period of 9 years from 1967 to 1975. The average inflow sediment discharge was estimated at 6,260,000 m^3/year, and the average sediment discharge at the reference point is 9,600,000 m^3/year as presented in Table VI-24. Consequently, the sediment balance was estimated at -3,340,000 m^3/year, and that the said volume is produced from the main stream by bed and bank erosions. Compared with the water discharge of 2×10^9 m^3/year on an average, the rate of sediment discharge to water discharge was calculated at approx. 0.5%.

2.4 Design Sediment Discharge

Sediment production and transport vary according to the amount of rainfall and geographical conditions. As described in Subsection 2.3, the total sediment discharge at El Vigía was estimated from approx. 15 to 20 x 10^6 m^3. Fine materials are transported up to the Maracaibo Lake, while coarse materials are deposited in the alluvial fan. The fine materials include all suspended load and a small part of wash load.

For the formulation of the basin-wide sediment control plan, the design sediment discharge was estimated at the reference point of El Vigía. Sediment discharges are defined as follows.

- Project Sediment Discharge is the discharge carried to the reference point by water flow of annual mean regime.

- Allowable Sediment Discharge (Sediment Transport Capacity) is the discharge which may be transported through the existing or proposed river channel downstream of the reference point without giving any damage and adverse effect on the channel and its area.

- Design Sediment Discharge is the remainder of the project sediment discharge after the allowable sediment discharge.

In the sediment discharge, only coarse material load which may be deposited in the river channel shall be counted in the estimation.

Project Sediment Discharge

The project sediment discharge was determined at 9,600,000 m^3/year which is the average sediment discharge for 9 years from 1967 to 1975. To obtain the sediment discharges of inflow, outflow and balance at all base points, an analysis on the transport and balance model was carried out under the following conditions:

- Sediment inflow discharge is estimated at 5,850,000 m^3/year, produced from slope erosion of 3,100,000 m^3/year, torrent erosion of 2,690,000 m^3/year and slope failure of 60,000 m^3/year which are projected to increase by 11.7% in 2020 using the US Soil Conservation's formula expressing an annual gully head advance.

- The daily discharge hydrograph of 1971 is adopted as a model hydrograph to compute sediment transport and balance in the basin.

The result of analysis is schematically presented in Fig. VI-22. Major sediment sources concentrate in the middle reaches of semi-arid area, especially Nuestra Señora, La Vizcaina and San Pablo river basins. Aside from the sediment production in the mountain slopes, another sediment production of 3,750,000 m^3/year also contributes to the sediment discharge at El Vigia.

Allowable Sediment Discharge

On the premise that the river channel downstream of El Vigia will be improved so as to carry the design flood of a 100-year return period, the allowable sediment discharge was evaluated for the proposed river improvement. The allowable sediment discharge is considered to be conveyed to the Maracaibo Lake without aggrading nor degrading the riverbed.

As mentioned in the Supporting Report on Flood Control, the proposed river improvement of the master plan has the following features.

Improvement Length	:	53.4 km
Standard Cross-Section	:	single with a width of 600 m
Dike	:	earth with a slope of 1:2.0

The sediment discharge which will pass the improved river channel is evaluated on the presumption that the sediment of rockfall materials shall mainly be transported through the river. Therefore, the grain size distribution of rockfall materials was applied to calculate the transport discharge.

The same formula of Ashida, Takahashi and Mizuyama was employed for the calculation. A representative cross-section where the sediment transport capacity is considered to be minimum was selected at the end of alluvial fan.

The sediment discharge computed using the model hydrograph of 1971 was 2,120,000 m^3/year at the representative section; hence, this discharge was determined to be the allowable sediment discharge.

Design Sediment Discharge

The design sediment discharge which is a part of the project sediment discharge exceeding the allowable sediment discharge was consequently estimated at 7,480,000 m^3/year. This sediment discharge shall be controlled to avoid aggradation of riverbed downstream of El Vigía.

Table VI-5 SAMPLING SITES OF RIVERBED MATERIALS

Site No.	River Name	Distance from Estuary (km)	Location
B-1	Chama	165	200m upstream of the Mucuruba Hydrological Station
B-2	Chama	150	1.5 km downstream of the confluence with La Mucuy River
B-3	Mucuy	---	1.0 km upstream of the confluence with the Chama River
B-4	Chama	136	150 m downstream of the El Chamita Bridge in Merida, 7.2 km downstream of the confluence with the Mucujun River
B-5	Mucujun	---	9.0 km upstream of the confluence with the Chama River
B-6	Chama	122	200 m upstream of the confluence with the Nuestra Senora River
B-7	Nuestra Senora	---	Near the town of El Morro, just confluence with the Mucusas River
B-8	Nuestra Senora	---	1.0 km upstream of the confluence with the Chama River
B-9	Chama	119	2.2 km downstream of the confluence with Nuestra Senora River
B-10	Gonzalez	---	1.0 km upstream of the confluence the Chama River
B-11	Chama	108	1.0 km downstream of the Puente Real Bridge
B-12	Chama	91	800 m upstream of the Chama No. 5 Bridge near the town of Estanquez
B-13	Mocoties	105	1.2 km upstream of the confluence with Sta. Cruz River
B-14	Chama	70	2.2 km downstream of the Chama Bridge in El Vigia City
B-15	Chama	65	Near the town of Aroa, 5.2 km downstream of the Chama Bridge in El Vigia City
B-16	Chama	48	Near the town of Los Naranjos
B-17	Chama	25	800 m downstream of the Puente Chama Bridge
B-18	Chama	10	Near the town of Sto. Domingo

Table VI-6 RESULTS OF SIEVE ANALYSIS FOR RIVERBED MATERIALS

SITE NO.	d10 (mm)	d50 (mm)	d60 (mm)	dm (mm)	Cu
B-1	4.4	118.0	150.0	116.0	34.0
B-2	0.8	32.0	60.0	73.0	75.0
B-3	1.5	200.0	250.0	168.0	167.0
B-4	0.8	25.0	40.0	46.0	53.0
B-5	2.9	58.0	100.0	107.0	35.0
B-6	0.5	34.0	68.0	67.0	136.0
B-7	0.8	14.0	24.0	32.0	30.0
B-8	1.6	39.0	58.0	50.0	36.0
B-9	0.9	9.0	17.0	41.0	20.0
B-10	1.9	130.0	200.0	125.0	105.0
B-11	0.8	12.0	19.0	22.0	25.0
B-12	0.6	4.0	6.0	9.0	11.0
B-13	0.5	21.0	29.0	28.0	54.0
B-14	0.6	13.0	17.0	19.0	28.0
B-15	---	0.6	0.7	---	---
B-16	---	---	---	---	---
B-17	---	---	---	---	---
B-18	---	---	---	---	---

Remarks: d10 : Effective diameter corresponding to 10% of the grain size accumulation curve.

d50 : Median diameter corresponding to 50% of the grain size accumulation curve.

d60 : Diameter corresponding to 60% of the grain size accumulation curve.

dm : Mean diameter as given below:

$$dm = \sum_{p=0}^{100} d\Delta p \;/\; \sum_{p=0}^{100} \Delta p$$

Cu : Hazen's uniformity coefficient as given below:
Cu = d60/d10

Note: No sieve analysis was performed at sites of B-16 to B-18, because all the grains were passed by the minimum sieve of 0.5 mm in diameter.

Table VI-7 AVERAGE GRAIN SIZE DISTRIBUTION FOR RIVERBED MATERIALS

(Unit: %)

Site No.	Average Grain Size Components		
	Silt and Sand	Gravel	Cobble
B- 1	11	30	59
B- 2	25	39	36
B- 3	16	27	57
B- 4	30	48	22
B- 5	14	42	44
B- 6	37	28	35
B- 7	31	57	12
B- 8	20	55	25
B- 9	40	38	22
B-10	17	23	60
B-11	38	58	4
B-12	54	46	0
B-13	34	59	7
B-14	35	63	2
B-15	90	10	0
B-16	100	0	0
B-17	100	0	0
B-18	100	0	0

Remarks: Silt : Less than 0.1 mm
Sand : 0.1 mm - 5 mm
Graval : 5 mm - 80 mm
Cobble : More than 80 mm

Table VI-8 COMPARISON OF SIEVE ANALYSIS RESULTS BETWEEN ARMOR COAT AND RIVERBED MATERIALS

(Unit: mm)

	B-1 Site		B-11 Site		B-14 Site	
	Armor Coat	Riverbed	Armor Coat	Riverbed	Armor Coat	Riverbed
d10	54	4.4	9	0.8	1.1	0.6
d50	220	118	70	12.0	25	13
d60	250	150	100	19.0	29	17
dm	210	116	84	22.0	25	19

Remarks: d10: Effective diameter corresponding to 10% of the grain size accumulation curve.

d50: Median diameter corresponding to 50% of the grain size accumulation curve.

d60: Diameter corresponding to 60% of the grain size accumulation curve.

dm: Mean diameter as given below;

$$dm = \sum_{p=0}^{100} d\Delta p \Big/ \sum_{p=0}^{100} \Delta p$$

Table VI-9 RECORD OF SUSPENDED LOAD MEASUREMENT AT MUCURUBA STATION

Measurement Date	Discharge (m3/s)	Concentration by Weight (%)
Nov.22 1973	7.73	0.0050
Oct.27 1976	5.24	0.0020
Nov.23	2.94	0.0020
Feb.22 1977	1.22	0.0050
Mar.22	1.17	0.0030
Jan.30 1978	1.36	0.0040
Feb.28	1.24	0.0060
Mar.15	0.93	0.0016
Apr.17	7.90	0.0050
May 26	4.96	0.0013
Jun.27	13.31	0.0060
Jul.27	9.85	0.0040
Aug.10	9.39	0.0040
Aug.15	13.87	0.0020
Sep.27	8.77	0.0020
Oct.19	4.00	0.0090
Nov.24	2.47	0.0044
Dec.12	2.64	0.0043
Jan.17 1979	1.58	0.0014
Feb.12	1.48	0.0041
Mar.16	1.42	0.0041
Mar.22	1.15	0.0020
Apr.20	1.67	0.0001
May 23	8.09	0.0042
Aug.29	3.65	0.0039
Sep.26	4.08	0.0063
Oct.25	9.22	0.0040
Oct.31	5.62	0.0030
Nov.15	5.53	0.0019
Nov.29	3.37	0.0018
Jan.16 1980	1.75	0.0018
Jan.23	1.77	0.0027
Feb.14 1980	1.45	0.0004
Apr.25	2.77	0.0020
May 15	5.60	0.0050
Oct. 7	6.68	0.0062
Oct.22	4.53	0.0069
Apr.22 1982	7.06	0.0809
May 14	7.27	0.0011
Jun.29	6.76	0.0022
Jul.20	11.19	0.0030
Jul.28	11.96	0.0033
Aug.20	7.39	0.0082
Nov.27	3.33	0.0062
Dec.16	1.67	0.0040
Feb.24 1983	1.34	0.0019
Mar.24	1.58	0.0083
May 4	8.18	0.0018
Jun.28	5.42	0.0025
Jul.14	9.96	0.0022
Aug.24	5.45	0.0033
Sep.23	9.11	0.0038
Oct.24	2.00	0.0104
Nov.28	3.08	0.0040
Dec.16	2.64	0.0025
Jan.31 1984	1.82	0.0036
Feb.14	1.44	0.0022
Mar.29	1.09	0.0026
Apr.26	0.87	0.0070
May 22	1.69	0.0064
Jun.27	7.40	0.0070
Aug.16	5.42	0.0019
Sep.27	9.10	0.0003

Table VI-10 RECORD OF SUSPENDED LOAD MEASUREMENT AT PUERTO CHAMA BRIDGE

Measurement Date	Discharge (m3/s)	Concentration by Weight (%)	Measurement Date	Discharge (m3/s)	Concentration by Weight (%)
Jan.26 1977	22.15	0.0300	Aug.26 1980	52.98	0.1210
Feb.23	17.46	0.0180	Sep.25	66.09	0.3530
May 26	43.67	0.1050	Oct. 7	159.10	0.3050
Jun.20	37.03	0.0360	Oct.14	82.99	0.3010
Jul.19	37.55	0.0430	Oct.28	46.97	0.0520
Aug.23	53.73	0.3600	Nov.12	63.64	0.1500
Sep.20	96.36	0.1220	Nov.24	76.64	0.2140
Oct.25	44.70	0.0530	Dec. 8	39.60	0.2040
Nov.15	112.80	0.2440	Dec.16	56.51	0.1360
Dec.20	24.52	0.1020	Jan.14 1981	30.36	0.1160
Jan.24 1978	18.86	0.0740	Jan.22	32.17	0.0930
Feb.21	19.59	0.0560	Jan.29	23.27	0.0650
Mar.28	30.62	0.0720	Feb. 9	26.67	0.0220
May 23	55.19	0.2440	Feb.18	22.43	0.0200
Aug.29	87.72	0.2320	Feb.25	48.41	0.1090
Jan.22 1979	25.30	0.0510	Mar.24	20.56	0.0220
Jan.30	24.00	0.0520	Sep.29	56.78	0.1610
Jul.25	81.47	0.2260	Oct.28	82.20	0.1390
Aug.29	54.14	0.1900	Nov.18	66.27	0.0490
Sep.25	56.78	0.0720	Nov.25	65.05	0.0580
Oct.25	156.12	0.3890	Sep.28 1982	83.82	0.0150
Nov.20	121.26	0.4120	Oct. 6	44.92	0.0600
Feb.12 1980	34.98	0.1840	Dec. 8	96.64	0.1100
May 28	89.95	0.5000	Apr.12 1983	46.86	0.0500
Jul.15	53.90	0.1500	May 17	99.10	0.3100
Aug.20	99.12	0.6290	Mar.27 1984	11.48	0.0270

Table VI-11 ANNUAL SUSPENDED LOAD DISCHARGE

Year	Water Discharge (m3/s)		Annual Sediment Discharge (1000 ton/year)	
	Maximum	Mean	Puerto Chama	Mucuruba
1967	452	54.3	9,275	7.9
1968	565	95.8	41,109	16.3
1969	687	93.2	51,329	16.1
1970	763	91.7	41,014	15.2
1971	411	59.6	11,628	8.4
1972	648	50.0	16,026	7.6
1973	303	49.2	8,935	7.6
1974	432	43.4	7,060	6.6
1975	303	58.5	8,624	9.0
Total		595.7	194,000	94.6
Average	518	66.2	21,550	10.5

Table VI-12 COMPARISON OF RIVERBED ELEVATIONS IN THE ALLUVIAL FAN

Section No.	Distance from Chama Bridge (km)	Riverbed Elevation (m)		Difference (m)
		1989	1975	
S-2	1.36	99.56	99.34	0.22
S-3	1.86	95.36	95.35	0.01
S-4	2.36	91.69	91.55	0.14
S-5	2.86	88.99	88.08	0.91
S-6	3.36	86.71	85.76	0.95
S-7	3.86	83.22	82.51	0.71
S-8	4.36	81.01	80.51	0.50
S-9	4.86	77.95	77.04	0.91
S-10	5.36	75.76	74.28	1.48
S-11	5.86	73.07	71.56	1.51
S-12	6.36	69.65	68.47	1.18
S-13	6.86	67.26	66.24	1.02
S-14	7.37	66.71	65.68	1.03
S-15	7.87	61.42	60.66	0.76
S-16	8.31	62.81	61.93	0.88
S-17	8.81	61.31	60.41	0.90
S-18	9.31	60.55	59.88	0.67
S-19	9.81	58.82	58.56	0.26
S-20	10.32	58.82	57.97	0.85
S-21	10.81	57.91	57.17	0.74
S-22	11.31	56.73	56.29	0.44
Average				0.77

Table VI-13 PARAMETERS FOR COMPUTATION OF SLOPE EROSION

No.	Sub-basin Area (km2)	Vegetation Cover: Forest (km2)	Grass (km2)	Denuded (km2)	Gully: Density (m/km2)	Ave.Length (m)	Slope Gradient
1	365.0	14.7	350.3	---	3,000	400	0.674
2	134.2	111.6	22.6	---	2,000	150	0.732
3	102.4	28.6	73.8	---	2,000	350	0.874
4	205.7	112.6	93.1	---	1,500	200	0.772
5	192.7	149.8	42.9	---	1,000	150	0.734
6	130.0	109.1	20.9	---	1,500	150	0.736
7	98.0	93.8	0.6	3.6	1,500	250	0.518
8	304.8	265.9	34.8	4.1	7,000	400	0.760
9	338.0	292.5	30.4	15.1	5,000	400	0.790
10	118.6	103.4	8.7	6.5	1,500	250	0.570
11	63.2	58.5	---	4.7	1,000	250	0.362
12	58.8	42.8	---	16.0	2,500	300	0.596
13	136.6	120.1	11.9	4.6	5,000	300	0.716
14	191.5	119.0	---	72.5	2,500	300	0.794
15	45.4	28.5	---	16.9	2,500	350	0.602
16	270.7	252.9	---	17.0	4,000	350	0.766
17	74.7	67.6	---	7.1	1,000	300	0.720
18	241.0	241.0	---	---	---	---	0.880
19	173.5	173.5	---	---	---	---	0.536
20	119.9	119.9	---	---	---	---	0.752
21	152.3	152.3	---	---	---	---	0.308
Total	3,517.0	2,658.1	690.0	168.9			

Los datos para "SED-PRO.EXE"
(@BASIC)

∴ "fórmula de Kohmura"

Tablo VI-14 PARAMETERS FOR COMPUTATION OF SLOPE FAILURE

Sub-basin Number	Slope Failure: Density (Site/km2)	Length (m)	Width (m)	Depth (m)	Non-effective Rainfall (mm)
1	5.0	250	20	1	100
2	1.3	100	30	2	100
3	0.5	200	100	5	30
4	0.3	70	20	1	100
5	0.5	150	80	5	50
6	0.3	150	30	1	100
7	1.5	100	30	2	100
8	---	---	---	---	50
9	---	---	---	---	50
10	0.3	100	70	5	100
11	---	---	---	---	100
12	---	---	---	---	30
13	---	---	---	---	30
14	3.0	200	100	1	30
15	---	---	---	---	30
16	---	---	---	---	100
17	4.0	70	10	2	125
18	4.0	100	10	2	125
19	3.0	70	10	2	125
20	2.0	70	10	2	125
21	0.5	100	20	3	100

Los Datos para " SED-PRO. EXE"

(Q BASIC)

: " fórmula de Uchiogi "

Table VI-15 PARAMETERS FOR COMPUTATION OF TORRENT EROSION

Sub-basin No.	Torrent/Stream Density (m/km2) 1st Order	2nd Order	3rd/More	All	Mean Diameter of Bed Load Materials (mm)
1	1,355.5	328.1	351.6	2,035.2	116
2	118.8	156.3	2,068.7	2,343.8	73
3	2,460.9	781.3	1,210.9	4,453.1	168
4	531.3	1,093.8	484.3	2,109.4	107
5	648.4	312.5	218.8	1,179.7	46
6	1,210.9	609.4	500.0	2,320.3	46
7	1,015.6	750.0	1,437.5	3,203.1	67
8	1,377.6	328.1	325.6	2,031.3	32
9	1,320.3	687.5	401.6	2,409.4	50
10	1,175.8	343.8	718.7	2,238.3	125
11	750.0	593.8	500.0	1,843.8	125
12	1,500.0	515.6	312.5	2,328.1	22
13	2,187.5	609.4	531.2	3,328.1	22
14	328.1	179.7	445.3	953.1	22
15	1,343.8	218.8	234.3	1,796.9	22
16	2,148.4	566.4	734.5	3,449.3	22
17	1,234.4	359.4	406.2	2,000.0	22
18	750.0	593.8	265.6	1,609.4	28
19	1,359.4	406.3	453.1	2,218.8	28
20	632.8	109.4	476.6	1,218.8	28
21	640.6	343.8	343.7	1,328.1	19

Note: Torrent gradients were assumed same as slope gradients shown in Table VI-13

Los datos para "SED-PRO.EXE"
(@BASIC)
: "fórmula de Brown"

Tablo VI-16 ANNUAL SEDIMENT PRODUCTION

Year	Rainfall (mm)		Sediment Production (1000 m3)		
	Annual Total	Maximum Daily	Annual Total *	Coarse Material	Maximum Daily
1967	1,129.7	17.1	25,282	5,596	772
1968	1,246.6	21.4	40,026	8,611	1,540
1969	1,432.4	31.6	69,372	14,579	2,674
1970	1,165.4	8.7	21,408	4,826	572
1971	1,327.8	22.5	24,650	5,434	1,135
1972	1,172.5	19.4	27,690	6,094	889
1973	1,165.0	19.1	21,037	4,707	660
1974	1,125.6	16.2	11,664	2,642	510
1975	1,287.7	11.1	17,267	3,849	782
1976	1,124.0	24.3	21,768	4,722	1,202
1977	923.6	22.7	17,901	3,932	1,074
1978	1,208.7	16.8	14,379	3,256	491
1979	1,337.7	10.6	34,734	7,782	957
1980	875.4	10.8	11,625	2,599	491
1981	1,436.9	17.7	47,366	10,036	1,339
1982	1,184.4	19.6	19,230	4,248	582
1983	986.4	14.8	19,962	4,403	721
1984	1,082.2	8.0	32,097	2,713	680
1985	1,227.8	10.5	16,442	3,703	656
1986	1,159.1	16.4	14,004	3,178	451
1987	941.8	26.5	28,985	3,174	1,446
Total	24,540.7	---	536,687	110,084	---
Maximum	1,436.9	31.6	69,372	14,579	2,674
Average	1,168.6	17.4	25,557	5,242	934

Note *: Including fine and coarse materials. fine m. = 25.557 - 5.242 = 20.320 $\times 10^3$ m^3/y

Resultados de cálculo de "SED-PRO.EXE"

Table VI-17 BASE POINTS FOR SEDIMENT BALANCE CALCULATION

Base Point	Location
BP-1	Chama River at the Mucuruba Hydrological Station
BP-2	La Sucia River at the confluence with the Chama River
BP-3	Chama River near the town of Tabay
BP-4	La Mucuy River at the confluence with the Chama River
BP-5	Chama River upstream of the confluence with the Mucujun River
BP-6	Mucujun River at the confluence with the Chama River
BP-7	La Gavidia River at the confluence with the Chama River, near the city of Merida
BP-8	Albarregas River at the confluence with the Chama River
BP-9	Chama River upstream of the confluence with the Albarregas River, near the town of Ejido
BP-10	Nuestra Senora River at the confluence with the Mucusas River, near the town of El Morro
BP-11	Tostos River at the confluence with the Nuestra Senora River
BP-12	Nuestra Senora River at the confluence with the Chama River
BP-13	Montalban River at the confluence with the Chama River
BP-14	Chama River upstsream of the confluence with La Gonzalez River
BP-15	La Gonzalez River at the confluence with the Chama River
BP-16	La Sucia River at the confluence with the Chama River
BP-17	Chama River upstream of the confluence with the La Vizcaina River, near the town of Puente Real
BP-18	El Arbolote River at the confluence with the Chama River
BP-19	La Vizcaina River at the confluence with the Chama River
BP-20	Chama River upstream of the confluence with the San Pablo River, near the town of San Pablo
BP-21	El Molino River at the confluence with the Chama River
BP-22	La Joya River at the confluence with the Chama River
BP-23	San Pablo River at the confluence with the Chama River
BP-24	Chama River upstream of the confluence with the Sto. Domingo River, near the town of Estanquez
BP-25	Sto. Domingo River at the confluence with the Chama River
BP-26	Mocoties River near the town of Tovar
BP-27	Mocoties River upstream of the confluence with the Mejias River, near ;the town of Sta. Cruz
BP-28	Mejias River at the confluence with the Mocoties River
BP-29	El Diamante River at the confluence with the Mocoties River
BP-30	Mocoties River upstream of the confluence with the Chama River
BP-31	Chama River upstream of the confluence with La Sucia River
BP-32	La Sucia River at the confluence with the Chama River
BP-33	Chama River near the city of El Vigia

Table VI-18 CATCHMENT AREA OF DIVIDED SUB-BASIN

Section No.	Sub-basin	Catchment Area (km2)
1	Chama	365.0
2	Local rivers	134.2
3	La Mucuy	102.4
4	Mucujun	205.7
5	Local rivers	192.7
6	Albarregas	130.0
7	Local rivers	98.0
8	Upper N. Senora	304.8
9	Lower N. Senora	338.0
10	La Gonzales	118.6
11	La Sucia	63.2
12	Local rivers	58.8
13	La Vizcaina	136.6
14	Local rivers	191.5
15	Local rivers	45.4
16	San Pablo	270.7
17	Sto. Domingo	74.7
18	Upper Mocotles	241.0
19	Lower Mocotles	173.5
20	Mejias	119.9
21	Mocacay & La Sucia	152.3
TOTAL		3,517.0

Table VI-19 DIMENSIONS OF DIVIDED CHANNEL SECTIONS

Channel No.	Location *1)	Length (km)	Width (m)
1	Chama River Qd. Estiti to La Mucuy River	12.00	30
2	Chama River La Mucuy River to Mucujun River	7.75	78
3	Chama River Mucujun River to Montalban River	13.26	105
4	Nuestra Senora Qd. Mucusuru to Chama River	16.25	66
5	Chama River Montalban River to La Gonzalez River	12.75	93
6	Chama River La Gonzalez River to La Viscaina River	10.50	116
7	Chama River La Viscaina to San Pablo River	10.25	210
8	Chama River San Pablo River to Mocoties River	9.75	130
9	Mocoties River Qd. San Francisco to Qd. Mejias	14.63	18
10	Mocoties River Qd. Mejias to Chama River	13.50	38
11	Chama River Mocoties to La Sucia River	6.88	75
12	Chama River La Sucia River to El Vigia	11.50	210

Note: Location of the channel section is indicated with rivers or streams of which confluences are located at upstream and downstream ends of the section.

Table VI-20 ASSUMED RIVER CONDITIONS BY BASE POINT FOR BED LOAD TRANSPORT ESTIMATION

Base Point	Reference	Assumed Sites of Riverbed Materials	Riverbed Slope
BP- 1	Sub-basin 1	B-1	1/15
BP- 2	Sub-basin 2	B-3	1/10
BP- 3	Channel 1	B-2	1/20
BP- 4	Sub-basin 3	B-3	1/10
BP- 5	Channel 2	B-4	1/25
BP- 6	Sub-basin 4	B-6	1/25
BP- 7	Sub-basin 5	B-3	1/10
BP- 8	Sub-basin 6	B-5	1/30
BP- 9	Channel 3	B-6	1/50
BP-10	Sub-basin 8	B-7	1/30
BP-11	Sub-basin 9	B-7	1/10
BP-12	Channel 4	B-8	1/20
BP-13	Sub-basin 7	B-5	1/20
BP-14	Channel 5	B-9	1/50
BP-15	Sub-basin 10	B-10	1/25
BP-16	Sub-basin 11	B-10	1/25
BP-17	Channel 6	B-11	1/66
BP-18	Sub-basin 12	B-10	1/8
BP-19	Sub-basin 13	B-10	1/5
BP-20	Channel 7	B-11	1/66
BP-21	Sub-basin 14	B-10	1/25
BP-22	Sub-basin 15	B-10	1/5
BP-23	Sub-basin 16	B-10	1/5
BP-24	Channel 8	B-12	1/66
BP-25	Sub-basin 17	B-13	1/44
BP-26	Sub-basin 18	B-13	1/30
BP-27	Channel 9	B-13	1/50
BP-28	Sub-basin 20	B-13	1/150
BP-29	Sub-basin 19	B-13	1/10
BP-30	Channel 10	B-13	1/100
BP-31	Channel 11	B-14	1/80
BP-32	Sub-basin 21	B-13	1/150
BP-33	Channel 12	B-14	1/100

Table VI-21 GRAIN SIZE DISTRIBUTION FOR RIVERBED MATERIALS

(Unit: %)

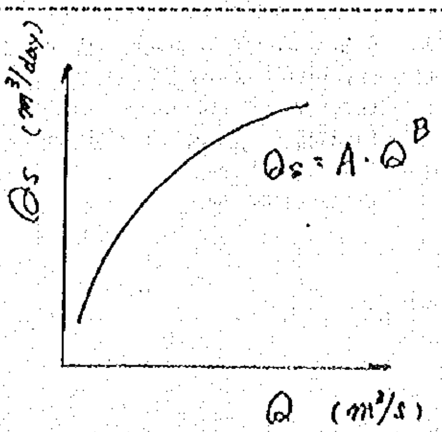
Sampling Site No.	Grain Size (mm)								
	d>200	200>d>100	100>d>50	50>d>30	30>d>10	10>d>5	5>d>1	1>d	Total
B-1	30	26	9	7	11	6	7	4	100
B-2	13	20	10	7	18	7	11	14	100
B-3	50	5	8	7	10	4	9	7	100
B-4	0	16	18	13	17	6	16	14	100
B-5	26	14	13	11	14	8	11	3	100
B-6	10	18	21	2	10	3	13	23	100
B-7	0	6	20	10	20	13	19	12	100
B-8	0	15	30	10	20	5	14	6	100
B-9	0	21	6	5	16	12	28	12	100
B-10	40	16	10	5	6	6	12	5	100
B-11	0	0	13	17	22	10	24	14	100
B-12	0	0	1	3	24	18	34	20	100
B-13	0	0	22	17	22	6	15	18	100
B-14	0	0	6	11	37	11	20	15	100

Tablo VI-22 CONSTANTS FOR BED LOAD RATING CURVE BY BASE POINT

Baso Point	Constants A	Constants B
BP-1	1,395	1.05
BP-2	2,113	1.01
BP-3	1,315	1.01
BP-4	2,113	1.01
BP-5	1,304	0.99
BP-6	845	1.06
BP-7	2,113	1.01
BP-8	674	1.07
BP-9	497	1.03
BP-10	1,232	0.98
BP-11	2,905	0.90
BP-12	1,640	0.99
BP-13	1,128	1.05
BP-14	662	1.01
BP-15	559	1.13
BP-16	559	1.13
BP-17	575	1.00
BP-18	2,829	0.96
BP-19	2,878	0.88
BP-20	575	1.00
BP-21	559	1.13
BP-22	2,878	0.88
BP-23	2,878	0.88
BP-24	746	0.96
BP-25	844	1.00
BP-26	1,277	0.97
BP-27	714	1.01
BP-28	169	1.07
BP-29	2,961	0.90
BP-30	501	1.00
BP-31	224	1.04
BP-32	1,243	1.07
BP-33	379	1.01

Note: Qs=A*Q^B

where; Qs : Sediment discharge (m3/day)
Q : Water discharge (m3/s)



ASHIDA. BAS ⇨

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Los datos para "NKASYO.FOR"

Tablo VI-23 CRITICAL TRACTIVE FORCE AND CRITICAL DISCHARGE AT BASE POINT

Base Point	dm (mm)	U*c (cm/s)	hc (m)	n	I	Qc (m3/s)
BP-1	210	41	0.26	0.04	1/15	11.6
BP-2	200	40	0.17	0.04	1/10	4.2
BP-3	150	35	0.25	0.04	1/20	7.6
BP-4	300	49	0.26	0.04	1/10	15.2
BP-5	130	32	0.27	0.04	1/25	7.9
BP-6	190	39	0.39	0.04	1/25	26.9
BP-7	200	40	0.17	0.04	1/10	4.2
BP-8	190	39	0.47	0.04	1/30	41.8
BP-9	120	31	0.60	0.04	1/50	30.9
BP-10	200	40	0.60	0.04	1/30	51.4
BP-11	200	40	0.17	0.04	1/10	4.2
BP-12	140	34	0.24	0.04	1/20	6.6
BP-13	190	39	0.31	0.04	1/20	15.6
BP-14	110	30	0.45	0.04	1/50	21.7
BP-15	230	43	0.47	0.04	1/25	50.2
BP-16	200	40	0.41	0.04	1/25	31.8
BP-17	90	27	0.59	0.04	1/66	3.9
BP-18	200	40	0.13	0.04	1/8	2.1
BP-19	200	40	0.08	0.04	1/5	0.7
BP-20	84	26	0.69	0.04	1/66	3.9
BP-21	200	40	0.41	0.04	1/25	31.8
BP-22	230	43	0.10	0.04	1/5	1.5
BP-23	230	43	0.10	0.04	1/5	1.5
BP-24	40	18	0.33	0.04	1/66	3.9
BP-25	150	35	0.43	0.04	1/44	26.6
BP-26	120	31	0.30	0.04	1/30	9.3
BP-27	100	28	0.41	0.04	1/50	15.9
BP-28	130	32	0.64	0.04	1/150	58.7
BP-29	130	32	0.11	0.04	1/10	1.0
BP-30	100	28	0.83	0.04	1/100	83.9
BP-31	25	14	0.31	0.04	1/80	2.1
BP-32	120	31	0.15	0.04	1/150	1.8
BP-33	25	14	0.31	0.04	1/100	2.1

Note; dm : Mean diameter of armor coat materials
U*c: Critical tractive force
hc : Critical water depth
n : Manning's roughness coefficient of riverbed
I : Riverbed slope
Qc : Critical discharge

↑ Los datos para "NKASYO. FOR."

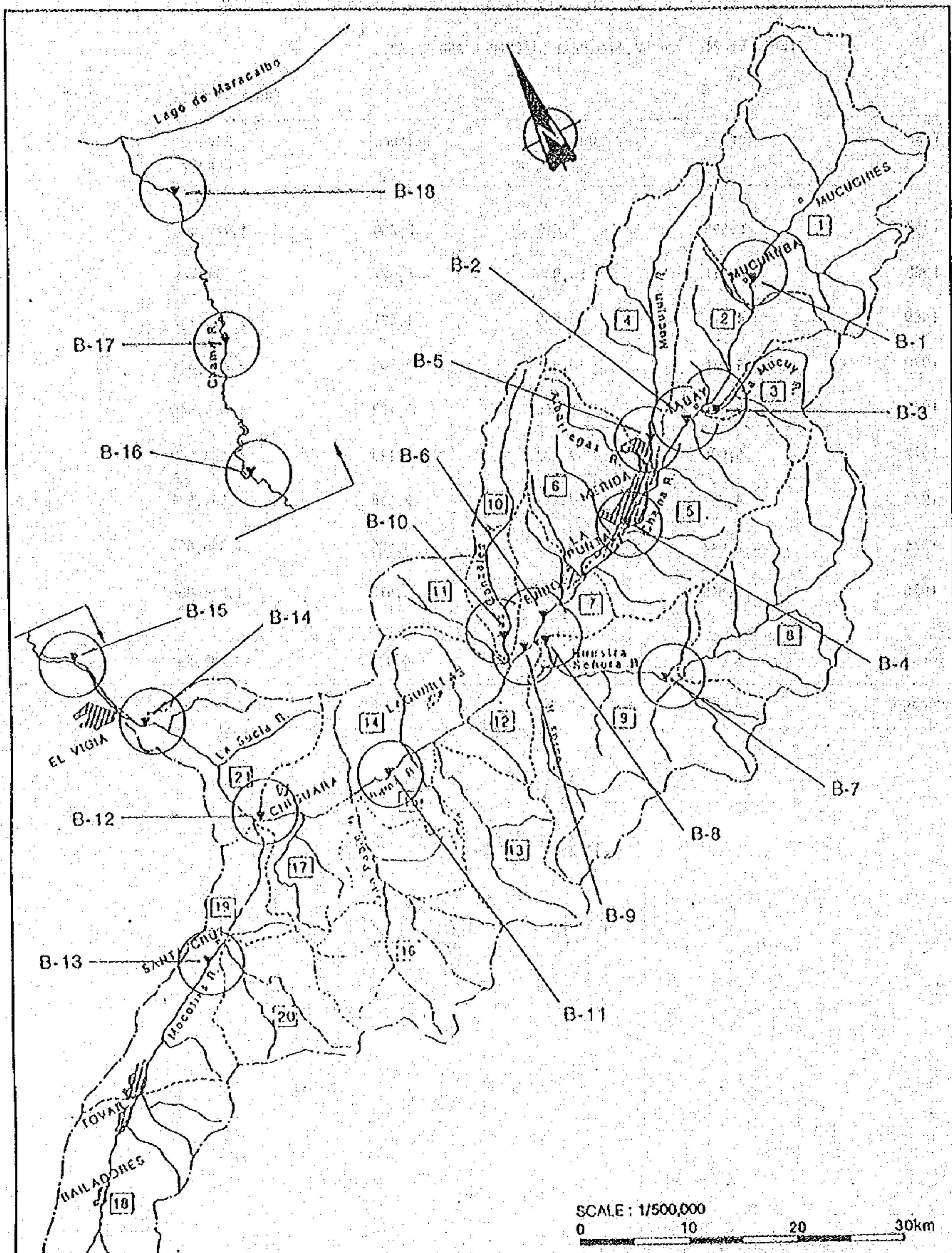
Table VI-24 ANNUAL SEDIMENT DISCHARGE AND BALANCE

(Unit: 1000m3)

Year	Inflow	Outflow	Balance	River Runoff
1967	5,596	7,846	-2,250	1,712,405
1968	8,611	13,938	-5,327	3,021,149
1969	14,579	13,558	1,021	2,939,155
1970	4,826	13,331	-8,505	2,891,851
1971	5,434	8,606	-3,172	1,879,546
1972	6,094	7,237	-1,143	1,576,800
1973	4,707	7,117	-2,410	1,551,571
1974	2,642	6,267	-3,625	1,368,662
1975	3,849	8,462	-4,613	1,844,856
Total	56,338	86,362	-30,024	18,785,995
Average	6,260	9,596	-3,336	2,087,333

NKASYO.FOR

OJO Fig. VI-22

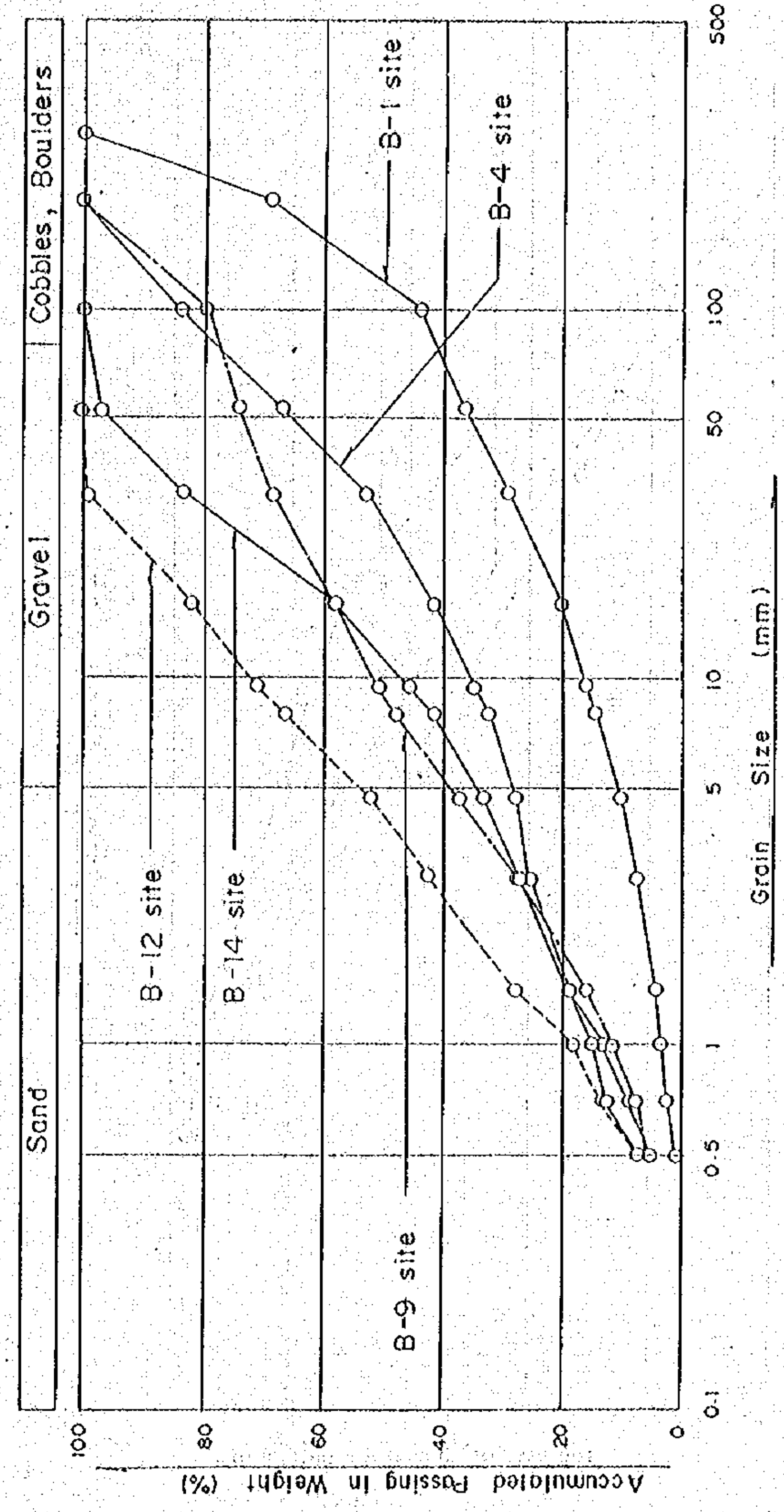


LOCATION MAP OF SAMPLING SITES FOR RIVERBED MATERIALS

Fig. VI-4

STUDY ON CHAMA RIVER BASIN CONSERVATION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

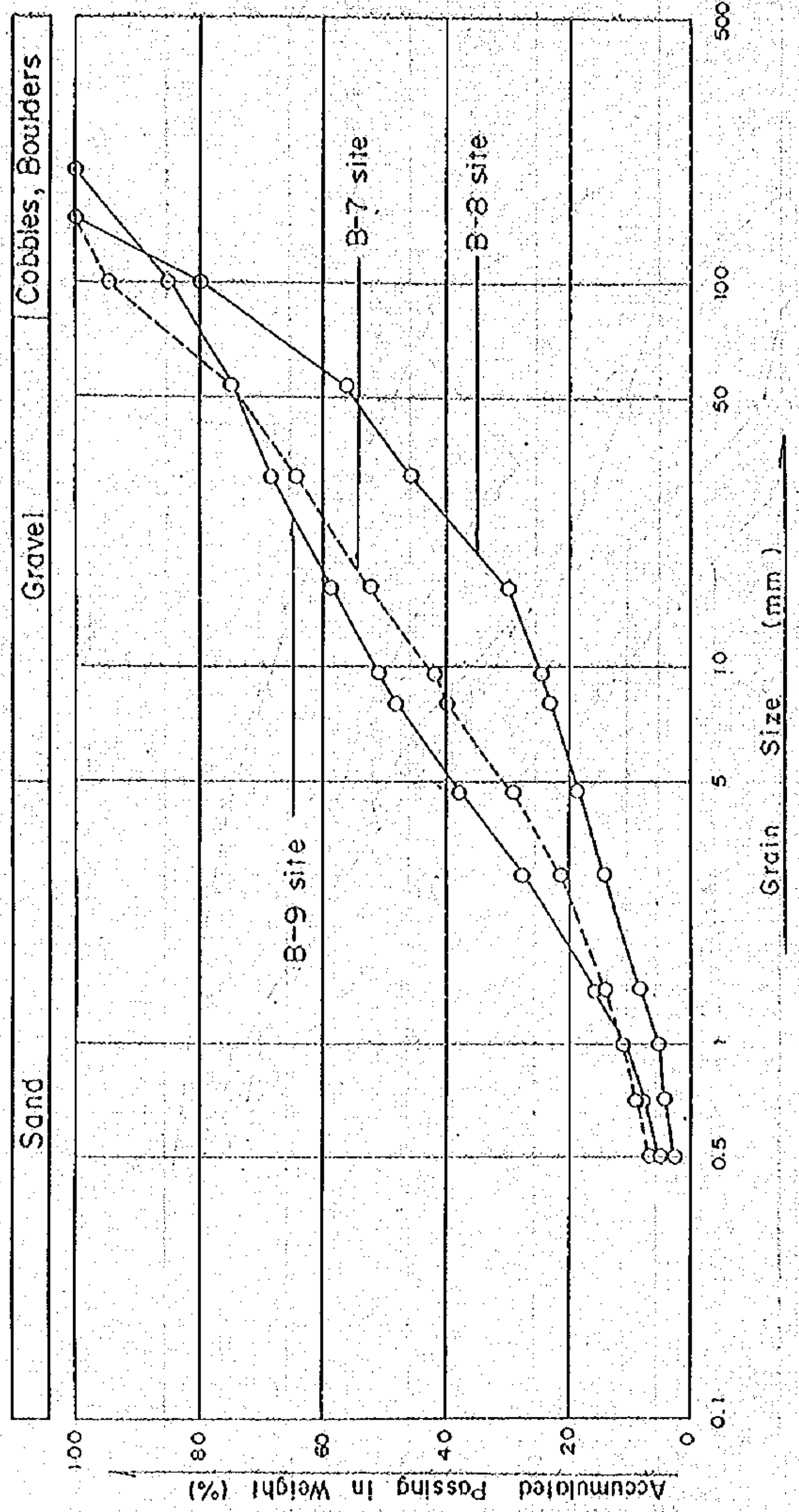


GRAIN SIZE ACCUMULATION CURVES OF RIVERBED MATERIALS IN CHAMA RIVER

Fig. VI-5

STUDY ON CHAMA RIVER BASIN CONSERVATION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

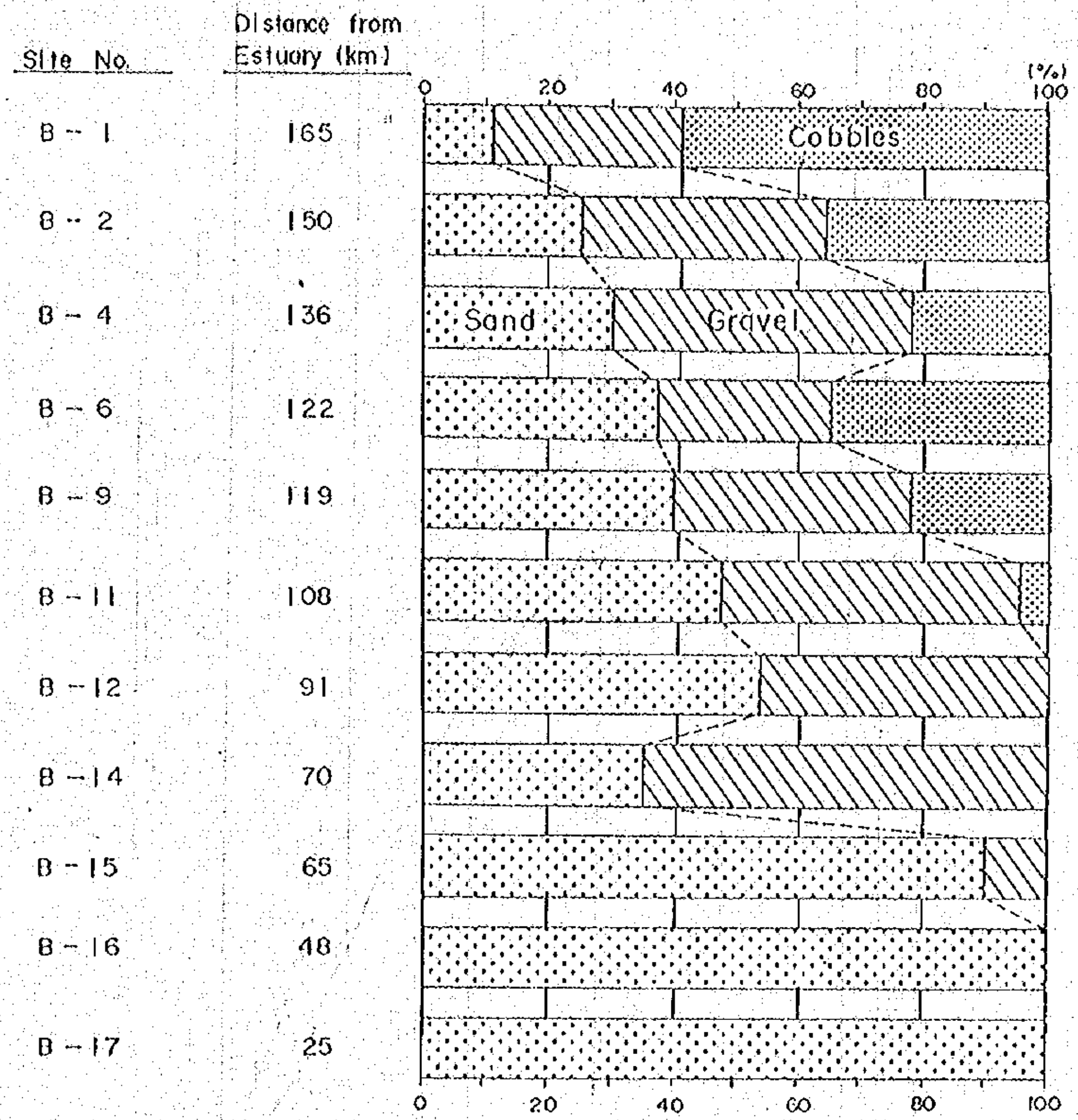


GRAIN SIZE ACCUMULATON CURVES OF RIVERBED MATERIALS IN NUESTRA SENORA RIVER

Fig. VI-6

STUDY ON CHAMA RIVER BASIN CONSERVATION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

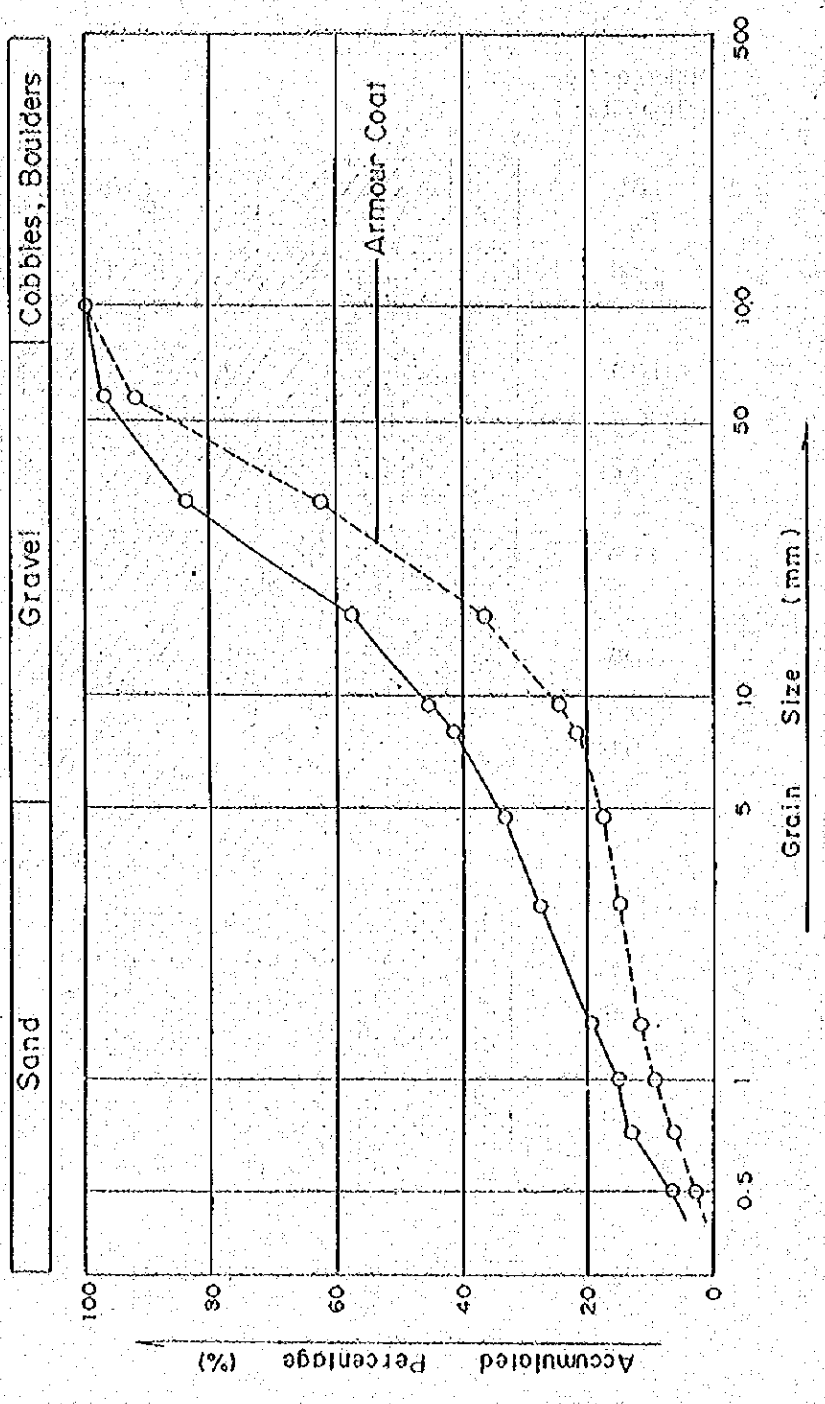


COMPARISON OF GRAIN SIZE DISTRIBUTION FOR RIVERBED MATERIALS IN CHAMA RIVER

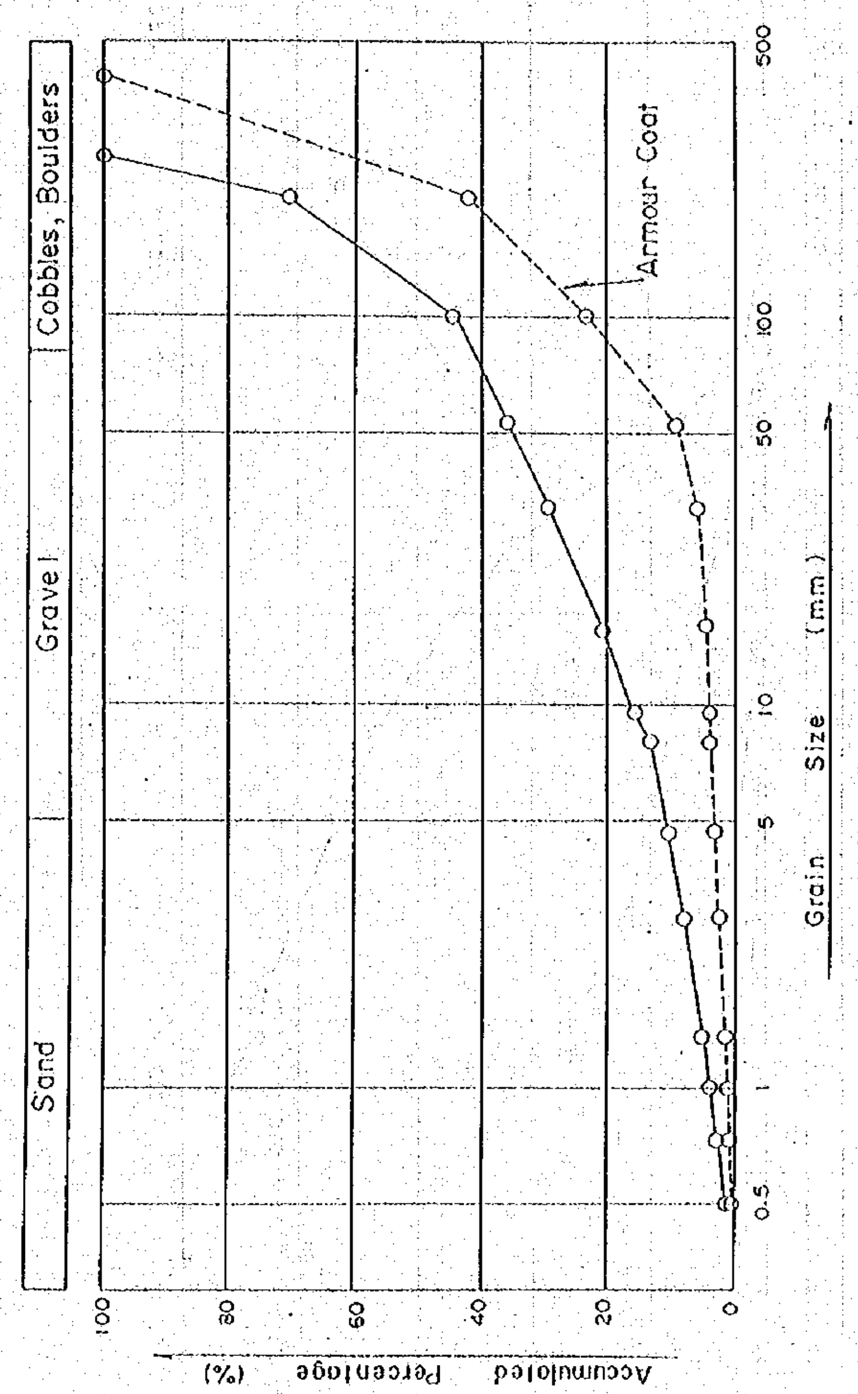
Fig. VI-7

STUDY ON CHAMA RIVER BASIN CONSERVATION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY



COMPARISON OF GRAIN SIZE ACCUMULATION CURVES FOR RIVERBED MATERIALS WITH ARMOR COAT IN CHAMA RIVER AT MUCURUBÁ Fig. VI-8	STUDY ON CHAMA RIVER BASIN CONSERVATION PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY

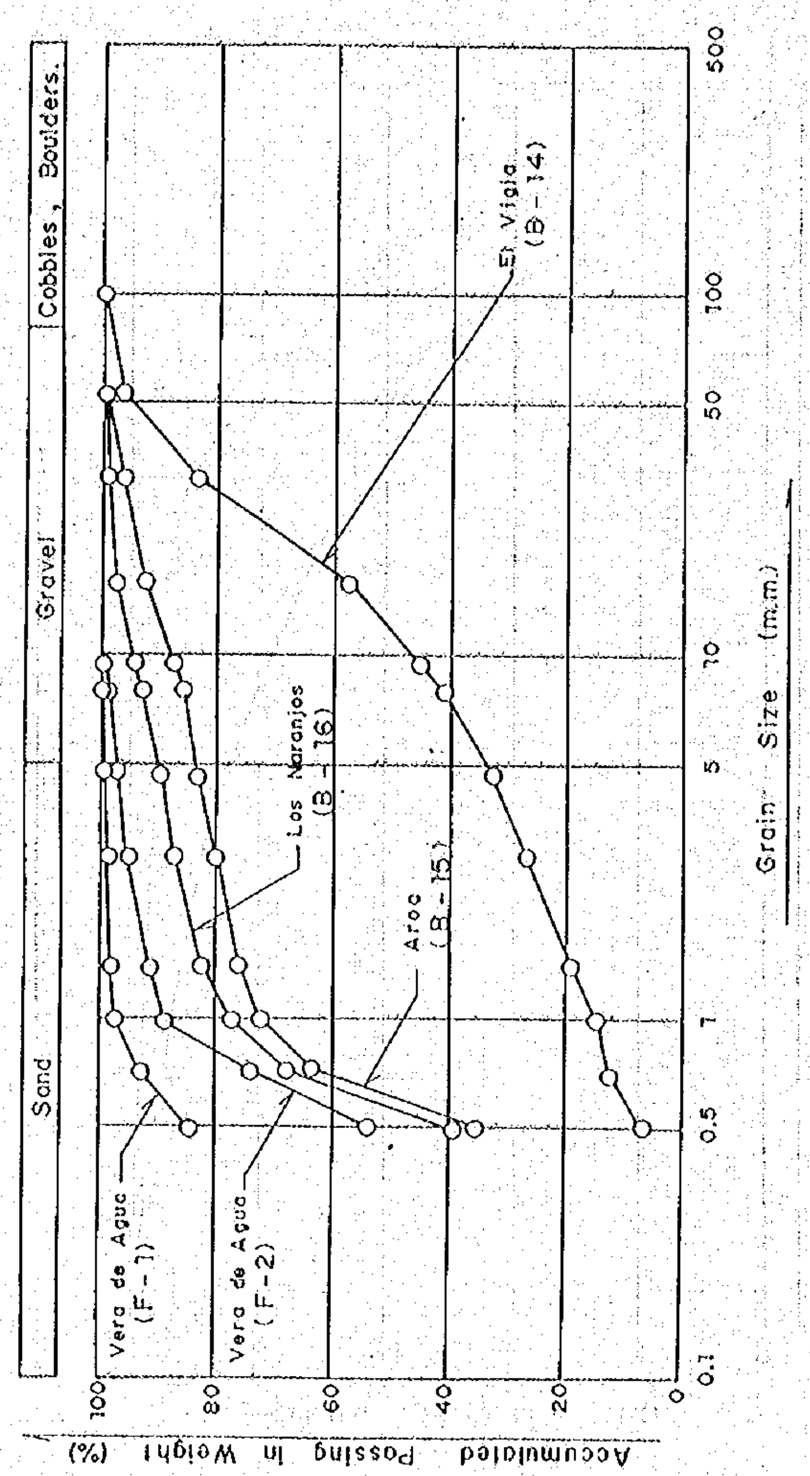


COMPARISON OF GRAIN SIZE ACCUMULATION CURVES FOR RIVERBED MATERIALS WITH ARMOR COAT IN CHAMA RIVER AT EL VIGÍA

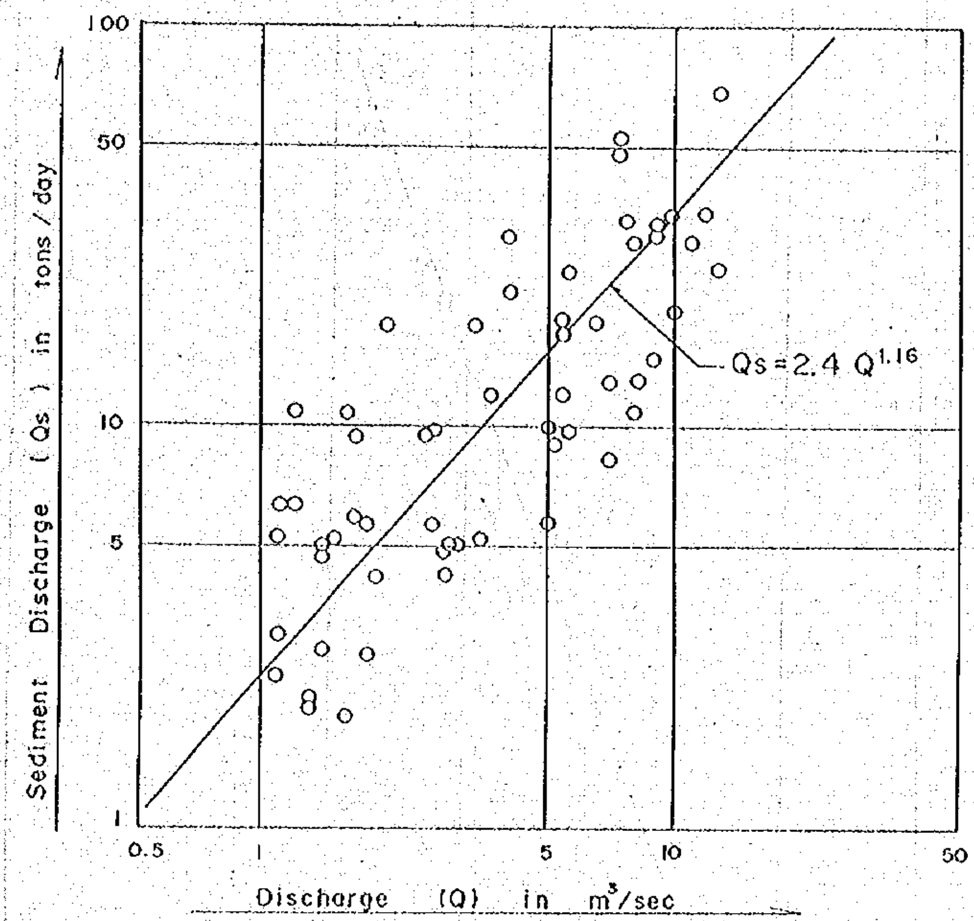
Fig. VI-9

STUDY ON CHAMA RIVER BASIN CONSERVATION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY



COMPARISON OF GRAIN SIZE ACCUMULATION CURVES FOR RIVERBED MATERIALS WITH ALLUVIAL FAN MATERIALS IN LOWER REACHES OF CHAMA RIVER Fig. VI-10	STUDY ON CHAMA RIVER BASIN CONSERVATION PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY

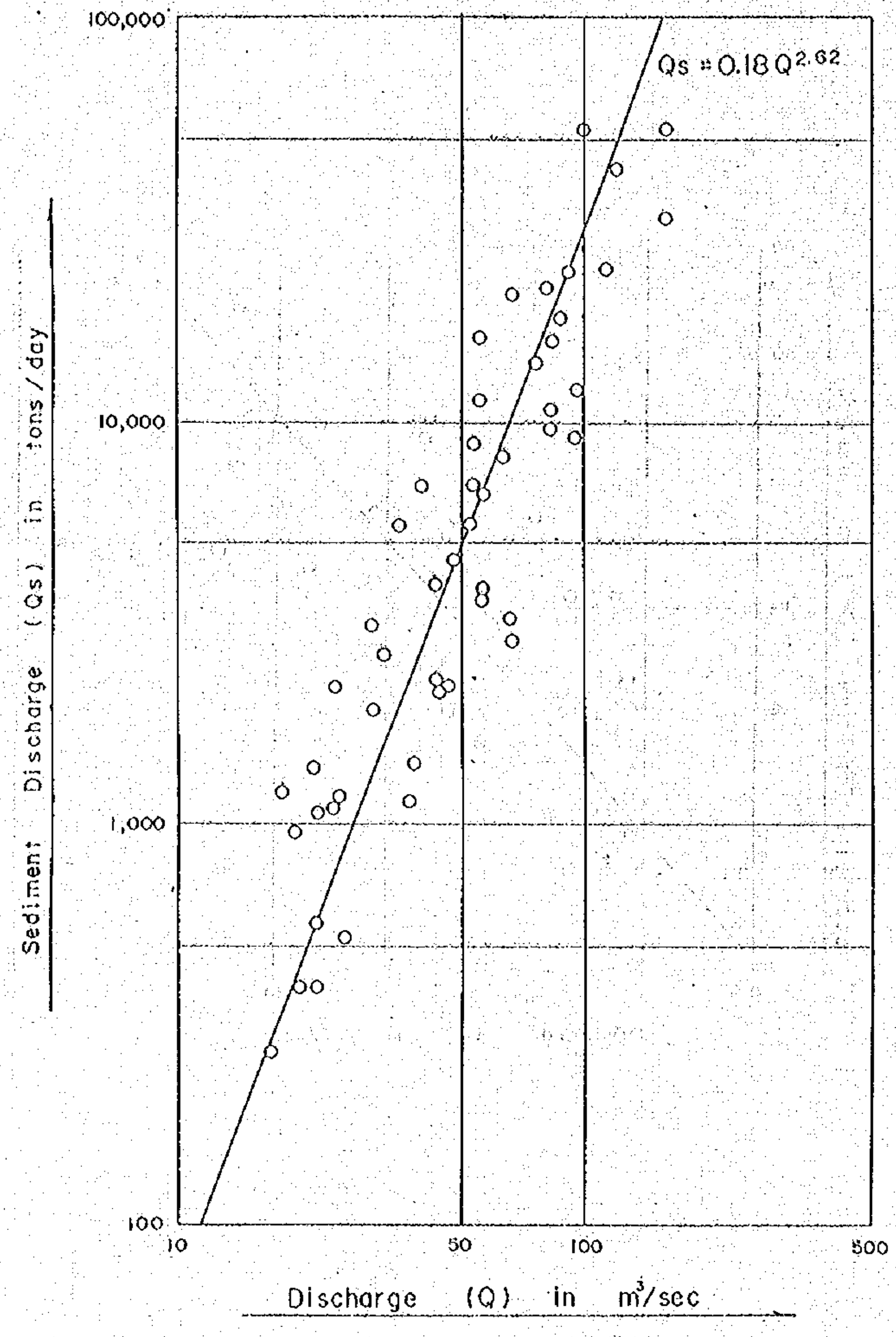


SUSPENDED LOAD RATING CURVE AT MUCURUBÁ STATION

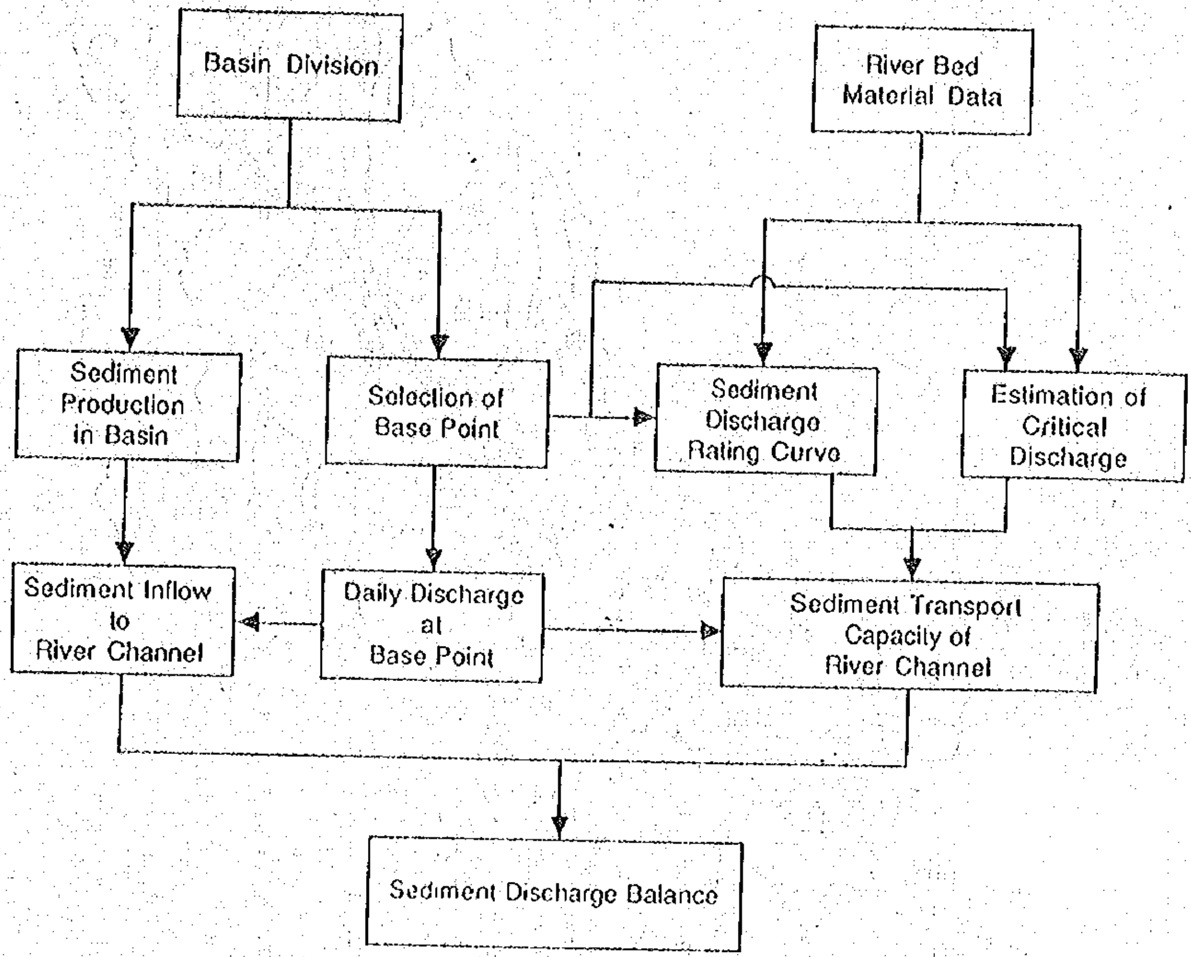
Fig. VI-11

STUDY ON CHAMA RIVER BASIN CONSERVATION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY



SUSPENDED LOAD RATING CURVE AT PUERTO CHAMA BRIDGE Fig. VI-12	STUDY ON CHAMA RIVER BASIN CONSERVATION PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY

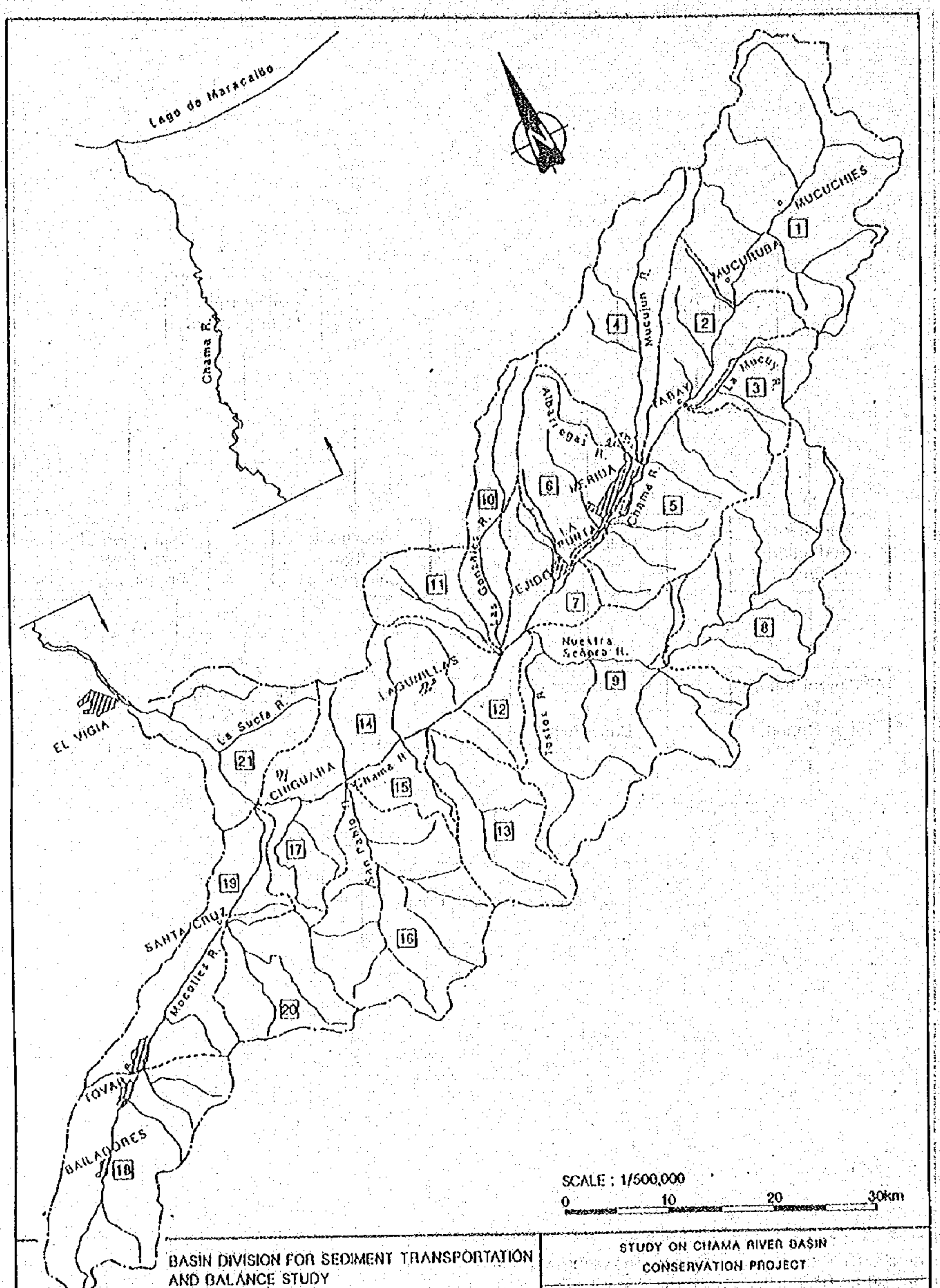


GENERAL PROCEDURE OF SEDIMENT TRANSPORTATION AND BALANCE STUDY

Fig. VI-17

STUDY ON CHAMA RIVER BASIN CONSERVATION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

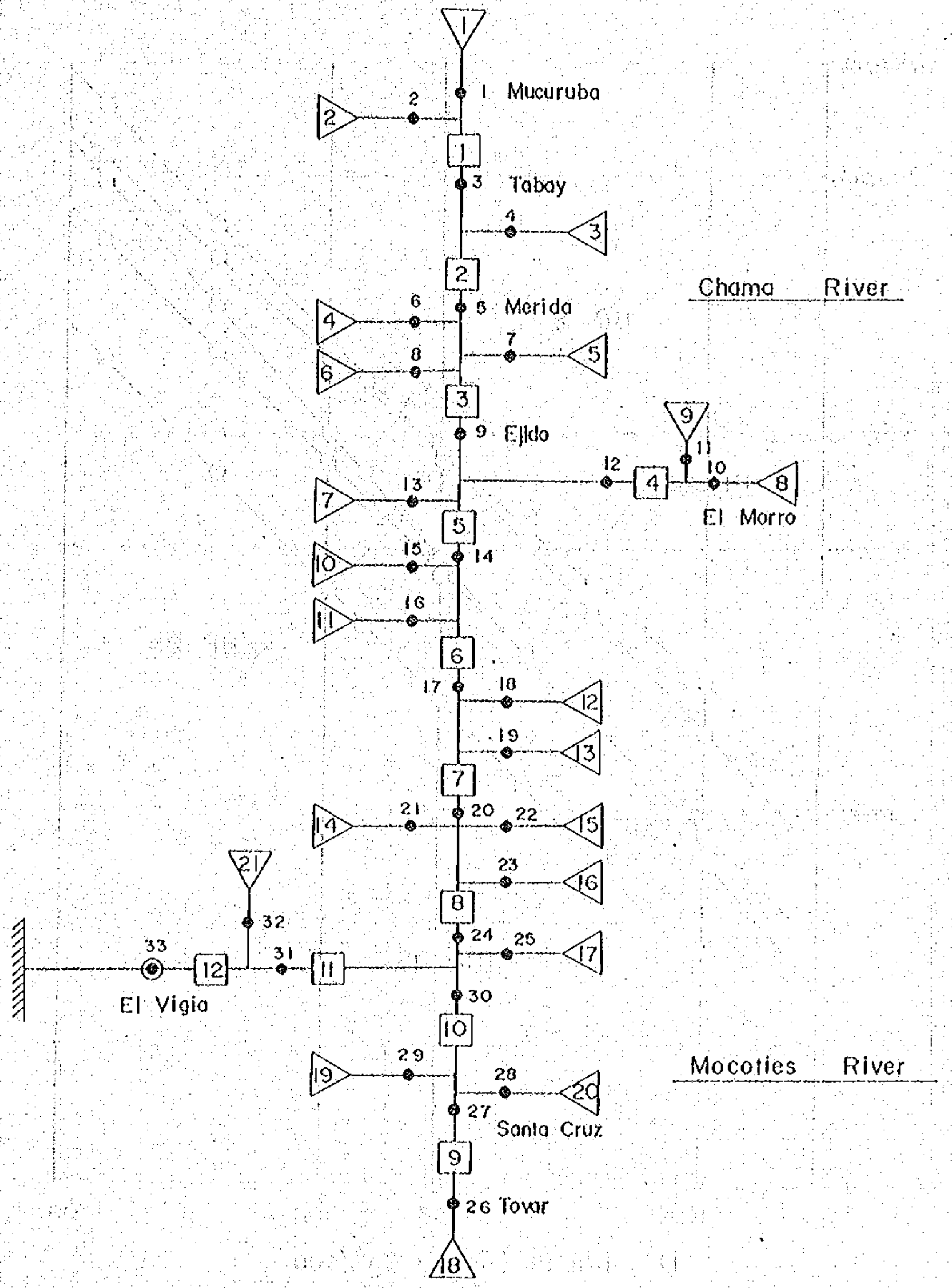


BASIN DIVISION FOR SEDIMENT TRANSPORTATION AND BALANCE STUDY

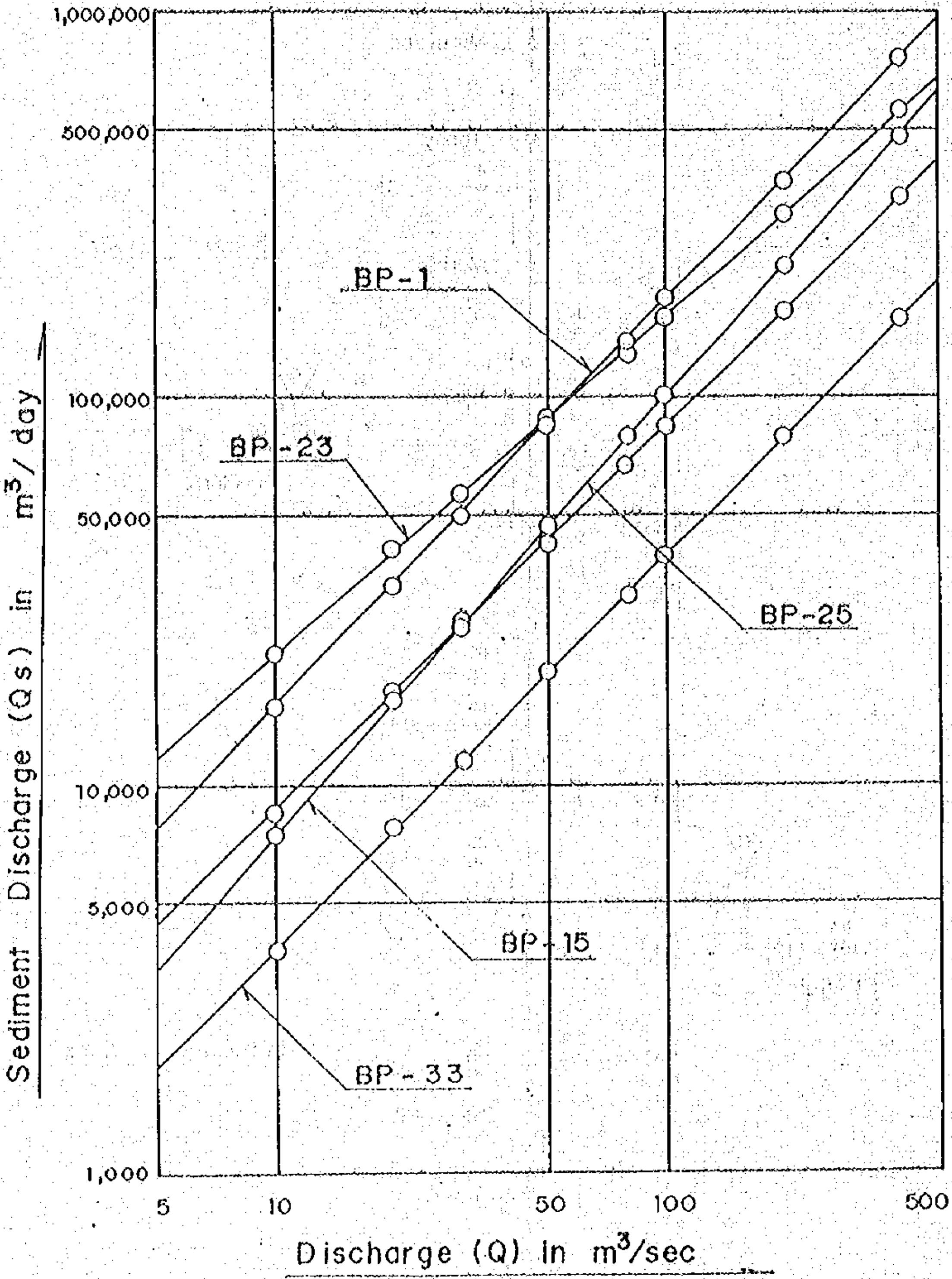
Fig. VI-18

STUDY ON CHAMA RIVER BASIN CONSERVATION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

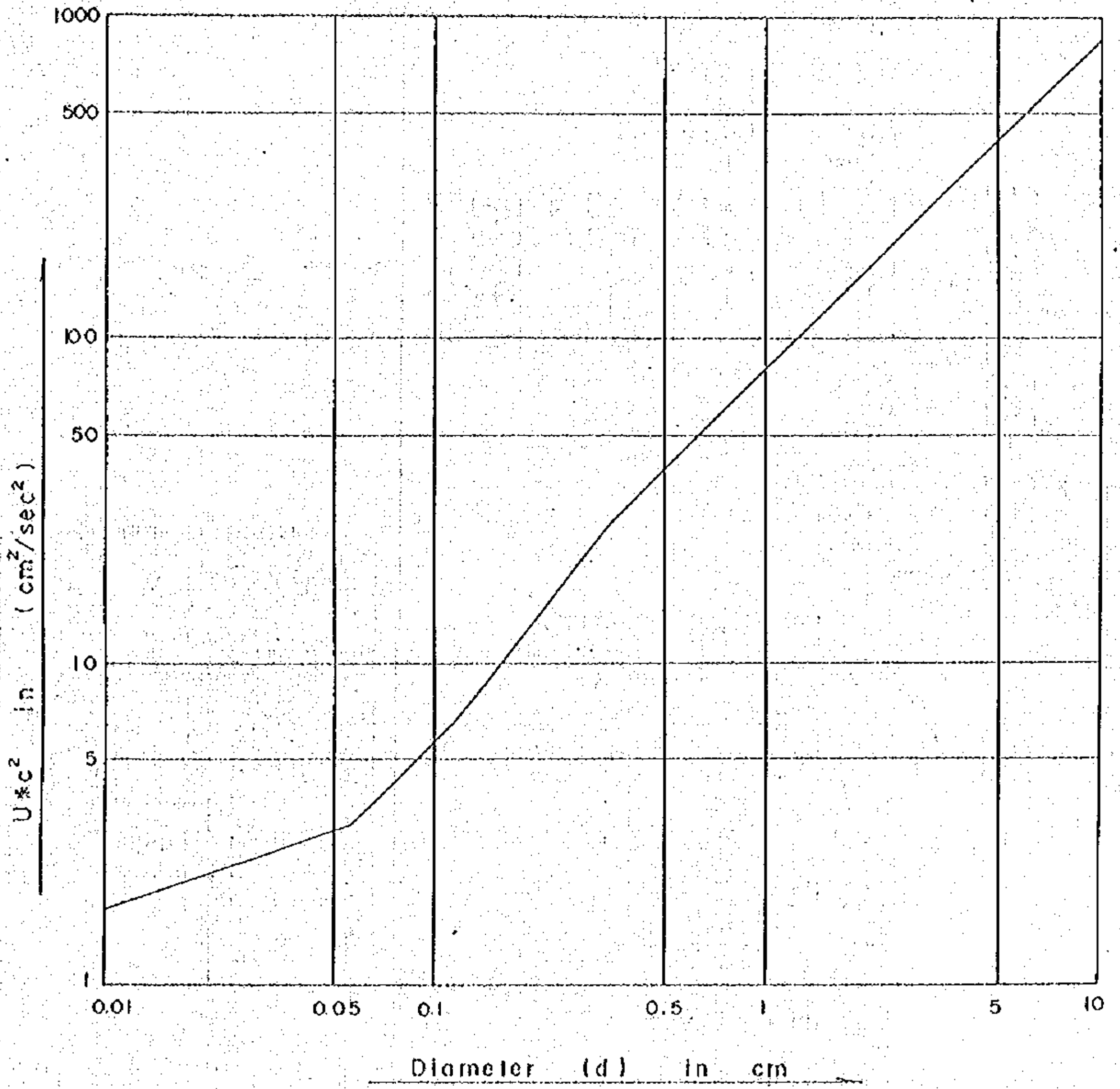


MODEL DIAGRAM FOR SEDIMENT TRANSPORTATION AND BALANCE STUDY Fig. VI-19	STUDY ON CHAMA RIVER BASIN CONSERVATION PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY



BED LOAD RATING CURVES AT BASE POINT	Fig. VI-20	STUDY ON CHAMA RIVER BASIN CONSERVATION PROJECT JAPAN INTERNATIONAL COOPERATION AGENCY

ASHIDA . BAS

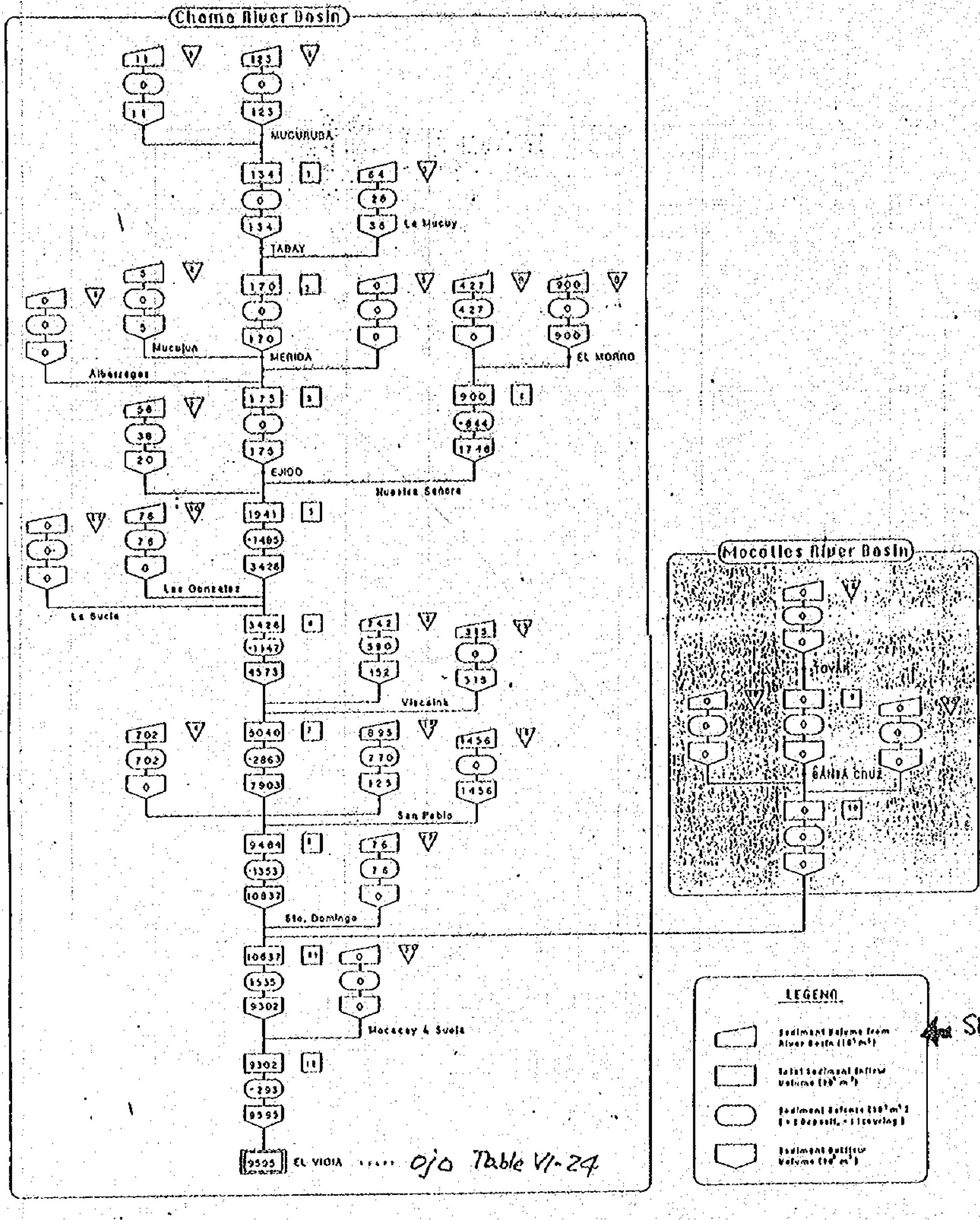


RELATION BETWEEN CRITICAL TRACTIVE FORCE AND GRAIN SIZE

Fig. VI-21

STUDY ON CHAMA RIVER BASIN CONSERVATION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY



DESIGN SEDIMENT BALANCE

Fig. VI-22

STUDY ON CHAMA RIVER BASIN CONSERVATION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

2. EXPLICACION SOBRE USO DE PROGRAMA DE COMPUTADORA

2.1 Cálculo de producción de sedimento

---- SED-PRO.EXE ----   QBASIC

SED-PRO 1

QBASIC

```
10  '**************************************************************
20  '****            PROGAAM FOR SEDIMENT PRODUCTION            ***
30  '****   CHAMA RIVER BASIN CONSERVATION PROJECT (VENEZUELA)  ***
40  '****   FILE = SED-PRO                                      ***
50  '****   JICA-CTIE     MARCH 1989                            ***
60  '**************************************************************
70  OPTION BASE 1
75  DIM SA(22), SAE(22), SAF(22), SAT(22), FL(22), FG(22), FD(22)
80  DIM RC(22), DM(22), D50(22), DA(22), DIM(22), FLL(22), FA(22)
90  DIM ROA(22), UL(22), UB(22), UI(22), CE(22), ARE(22)
100 DIM KRR(22), RN(22), CG(22), AD(22), ARF(22), CCA(22), UC(22), HC(22)
110 DIM TO(22), TTO(22), TI(22), SN(22), POT(22), NNP(22), SR(22), SQS(22), SQE(22), SQF(22), SQT(22), SQQ(22)
120 DIM R(22, 73), RR(22, 73), Q(22, 73), DUH(121)
130 DIM QE(22, 73), QF(22, 73), QI(22, 73), QS(22, 73), ERF(22, 73)
132 DIM E1(22, 73), E2(22, 73), E3(22, 73), ET1(22), ET2(22), ET3(22)
135 DIM PBBS(22), ASBL(22)
140 DEFINT I-R
145 DEFSNG K, N
150 WIDTH LPRINT 200
160 LPRINT CHR$(27) + "H"
162 CLS : LOCATE 10, 10: INPUT "Printout of Hourly Sediment Production (Y/N)"; P$
164 CLS : LOCATE 10, 10: INPUT "Number of Subbasins"; NS
166 LOCATE 12, 12: INPUT "Number of Computation Steps"; R
168 'INPUT "Starting Year, Month, Day, Time"; IY, IM, ID, IT
170 'PRINT "Runoff Coefficient and Land Use": PRINT "Runoff Ratio for Land Use"
172  CRF = .4
174  CRG = .6
176  CRO = .8
178 '
180 CLS : LOCATE 10, 10
182 INPUT "Compute Wash Load (Y/N)"; WS$
200 PRINT "
201 PRINT "  >>>>  CHOOSE PROBABILITY >>>>> ???  "
202 PRINT " *-----------------------------------*"
203 PRINT "    100-YEAR   >>>>>   ( 1 )          "
204 PRINT "     50-YEAR   >>>>>   ( 2 )          "
205 PRINT "     30-YEAR   >>>>>   ( 3 )          "
206 PRINT "     10-YEAR   >>>>>   ( 4 )          "
207 PRINT "      5-YEAR   >>>>>   ( 5 )          "
208 PRINT "      2-YEAR   >>>>>   ( 6 )          "
209 PRINT " *-----------------------------------*"
210 PRINT " "
211 INPUT " Probability = "; PT$
212 '
216 '
217 '*******             BASIC DATA INPUT                   *********
218 '
219 CLS : LOCATE 3, 5
220 PRINT "Input Basic Data of Subbasins"
230 FOR I1 = 1 TO NS
231 READ SA(I1):                 '' Subbasin Area (km2)
232 NEXT I1
240 FOR I11 = 1 TO NS
242 READ SAE(I11):               '' Area for Slope Erosion (km2)
244 NEXT I11
246 FOR I12 = 1 TO NS
248 READ SAF(I12):               '' Area for Slope Failure (km2)
250 NEXT I12
252 FOR I13 = 1 TO NS
254 READ SAT(I13):               '' Area for Torrent (km2)
256 NEXT I13
308 FOR I2 = 1 TO NS
309 READ FL(I2):                 '' Forest Land Area (km2)
310 NEXT I2
311 FOR I21 = 1 TO NS
312 READ FG(I21):                '' Grassland Area (km2)
313 NEXT I21
314 FOR I22 = 1 TO NS
315 READ FD(I22):                '' Denuded Area (km2)
316 NEXT I22
317 FOR I23 = 1 TO NS
318 READ FLL(I23):                '' Density of 1st Order Torrent (m/km2)
319 NEXT I23
320 FOR I24 = 1 TO NS
321 READ FA(I24):                '' Occupied Area Ratio of 1st Order Torrent
322 NEXT I24
323 FOR I25 = 1 TO NS
324 READ DMM(I25):               '' Mean Sediment Size in Mountain (mm)
325 NEXT I25
326 FOR I3 = 1 TO NS
327 READ DM(I3):                 '' Mean Sediment Size (mm)
328 NEXT I3
329 FOR I4 = 1 TO NS
330 READ D50(I4):                '' 50% Sediment Size (mm)
340 NEXT I4
342 FOR I5 = 1 TO NS
344 READ DA(I5):                 '' Particle Size for Armour Coat (cm)
346 NEXT I5
380 FOR I6 = 1 TO NS
390 READ UL(I6):                 '' Length of Unit Slope (m)
400 NEXT I6
410 FOR I7 = 1 TO NS
420 READ UB(I7):                 '' Width of Unit Slope (m)
430 NEXT I7
440 FOR I8 = 1 TO NS
450 READ UI(I8):                 '' Gradient of Unit Slope
460 NEXT I8
470 FOR I9 = 1 TO NS
480 READ CE(I9):                 '' Erodability Coefficient
490 NEXT I9
501 FOR I101 = 1 TO NS
502 READ ARE(I101):              '' Arriving Rate from Erosion
503 NEXT I101
504 FOR I10 = 1 TO NS
510 READ KRR(I10):               '' Relief Ratio
520 NEXT I10
530 FOR I11 = 1 TO NS
540 READ RN(I11):                '' Non-effective Rainfall (mm)
550 NEXT I11
560 FOR I12 = 1 TO NS
570 READ CG(I12):                '' Coefficient G
580 NEXT I12
590 FOR I13 = 1 TO NS
600 READ AD(I13):                '' Averaged Failure Depth (m)
610 NEXT I13
611 FOR I131 = 1 TO NS
612 READ ARF(I131):              '' Arriving Rate from Failure
613 NEXT I131
620 FOR I14 = 1 TO NS
630 READ TO(I14):                '' Torrent's Density (m/km2)
640 NEXT I14
642 FOR I1 = 1 TO NS
644 READ TTO(I1):                '' Total Torrent's Density (m/km2)
646 NEXT I1
650 FOR I15 = 1 TO NS
660 READ TI(I15):                '' Torrent's Gradient
670 NEXT I15
```

```
680  FOR I16 = 1 TO NS
690  READ SN(I16):              '* Roughness Coefficient of Torrent
700  NEXT I16
710  FOR I17 = 1 TO NS
720  READ PDT(I17):             '* Possible Erodable Depth of Torrent (m)
730  NEXT I17
735  '
740  '++++++++++  Input Number of Rain and Discharge  ++++++++++++
750  FOR J = 1 TO NS
760  READ NNP(J):               '* Output Points of Rainfall and Discharge
770  NEXT J
780  '
790  '***********         DATA LIST         ********************
800  '
810  '---  SUBBASIN AREA : SA(I)  ---
820  DATA 365.0,134.2,102.4,205.7,192.7,130.0,98.0,304.8,338.0,118.6,63.2,58.8,136.6,191.5,45.4,270.7,74.7,241.0,173.5,119.9,152.3
822  '---  AREA FOR SLOPE EROSION : SAE(I)  ---
824  DATA 238.6,84.2,0,142.3,173.8,64.6,39.0,296.1,338.0,34.9,0,58.4,136.6,0,45.4,270.7,0,0,0,0,0
825  '---  AREA FOR SLOPE FAILURE : SAF(I)  ---
826  DATA 125.0,42.6,94.1,51.5,33.0,40.5,31.9,0,0,56.1,3.0,0,0,87.8,0,0,72.0,227.1,167.6,119.9,63.2
827  '---  AREA FOR TORRENT : SAT(I)  ---
828  DATA 1.4,7.4,2.6,0,5.9,24.9,14.1,0,0,5.2,1.1,.4,0,20.0,0,0,2.7,13.9,5.9,0,1.7
830  '---  FOREST LAND   : FL(I)  ---
840  DATA 14.7,116.6,28.6,112.6,149.8,109.1,93.8,265.5,292.5,103.4,58.5,42.8,120.1,119.0,28.5,252.9,67.6,241.0,173.5,119.9,152.3
850  '---  GRASSLAND     : FG(I)  ---
860  DATA 350.3,22.6,73.8,93.1,42.9,20.9,0.6,34.8,30.4,8.7,0,0,11.9,0,0,0,0,0,0,0,0
870  '---  DENUDED AREA  : FD(I)  ---
880  DATA 0,0,0,0,0,3.6,4.1,15.1,6.5,4.7,16.0,4.6,72.5,16.9,17.8,7.1,0,0,0,0
890  '---  DENSITY OF 1ST ORDER TORRENT : FLL(I)  ---
895  DATA  21688,19000,39375,8500,10375,19375,16250,22042,21125,18813,12000,24000,35000,5250,21500,34375,19750,12000,21750,10125,10250
897  '---  OCCUPIED AREA RATIO OF 1ST ORDER TORRENT : FA(I)  ---
899  DATA  .67,.51,.55,.47,.55,.52,.32,.68,.66,.53,.41,.64,.66,.34,.75,.72,.62,.47,.61,.52,.48
900  '---  SEDIMENT MEAN SIZE IN MOUNTAIN : DMM(I)  ---
910  DATA .1,.1,.1,.1,.1,.1,.1,.1,.1,.1,.1,.1,.1,.1,.1,.1,.1,.1,.1,.1,.1
930  '---  SEDIMENT MEAN SIZE  : DM(I)  ---
940  DATA 116,73,168,107,46,46,67,32,50,125,125,22,22,22,22,22,22,28,28,28,19
950  '---  SEDIMENT 50 % SIZE  : D50(I)  ---
960  DATA 118,32,200,58,25,25,34,34,39,130,130,12,12,12,12,12,12,21,21,21,13
965  '---  PARTICLE SIZE FOR ARMOUR COAT DA(I)  ---
967  DATA 11,8,3,2,2.0,5,8,2.5,2.5,3,4,1.4,1.4,13,13,1.2,1.2,1.2,1.2,12,12,21,21,2.1,1.3
970  '---  LENGTH OF UNIT SLOPE: UL(I)  ---
980  DATA 100,100,100,100,100,100,100,100,100,100,100,100,100,100,100,100,100,100,100,100,100
990  '---  WIDTH OF UNIT SLOPE : UB(I)  ---
1000 DATA 2035,2343,4453,1141,1180,2320,3203,2031,2012,2238,1844,2328,3328,953,1797,2984,2000,1609,2219,1219,1328
1010 '--- GRADIENT OF UNIT SLOPE :UI(I)  ---
1020 DATA .674,.732,.874,.772,.734,.736,.518,.760,.790,.570,.362,.596,.716,.794,.602,.766,.720,.880,.536,.752,.308
1030 '---  ERODABILITY COEFFICIENT : CE(I)  ---
1040 DATA 10.4,10.4,10.4,10.4,10.4,10.4,10.4,10.4,10.4,10.4,10.4,10.4,10.4,10.4,10.4,10.4,10.4,10.4,10.4,10.4,10.4
1050 '---  ARRIVING RATE FROM EROSION : ARE(I)  ---
1060 DATA .5,.5,.5,.5,.5,.5,.5,.5,.5,.5,.5,.5,.5,.5,.5,.5,.5,.5,.5,.5,.5
1070 '---  RELIEF RATIO : XRR(I)  ---
1080 DATA 1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
1090 '---  NON-EFFECTIVE RAINFALL FOR SLOPE FAILURE : RN(I)  ---
1100 DATA 100,100,30,100,50,100,100,50,50,100,100,30,30,30,30,100,125,125,125,125,100
1110 '---  COEFFICIENT G  : CG(I)  ---
1120 DATA 5,5,5,5,5,5,5,5,5,5,5,5,5,5,5,5,5,5,5,5,5
1130 '---  AVERAGED FAILURE DEPTH : AD(I)  ---
1140 DATA 2,2,10,5,2,2,5,5,2,5,5,2,2,5,2,2,2,2,2,2,2
1150 '---  ARRIVING RATE FROM FAILURE : ARF(I)  ---
1151 DATA .2,.2,.2,.2,.2,.2,.2,.2,.2,.2,.2,.2,.2,.2,.2,.2,.2,.2,.2,.2,.2
1152 '---  TORRENT'S DENSITY : TD(I)  ---
1153 DATA 1683.6,1343.8,3242.2,1625.0,960.9,1820.3,1765.6,1705.8,2007.8,1519.6,1343.8,2015.6,2796.9,507.8,1562.5,2714.9,1593.8,1343.8,1765.6,742
1155 '---  TOTAL TORRENT'S DENSITY : TTD(I)  ---
1157 DATA 2035.2,2343.8,4453.1,2109.4,1179.7,2320.3,3203.1,2031.3,2409.4,2238.3,1843.8,2328.1,3328.1,953.1,1796.9,3449.3,2000.0,1609.4,2218.8,12
1182 '---  TORRENT'S GRADIENT : II(I)  ---
1184 DATA .674,.732,.874,.772,.734,.736,.518,.760,.790,.570,.362,.596,.716,.794,.602,.766,.720,.880,.536,.752,.308
1185 '---  TORRENT'S ROUGHNESS COEFFICIENT : SN(I)  ---
1186 DATA .05,.05,.05,.05,.05,.05,.05,.05,.05,.05,.05,.05,.05,.05,.05,.05,.05,.05,.05,.05,.05
1187 '---  POSSIBLE ERODABLE DEPTH : PDT(I)  ---
1188 DATA 1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
1190 '---  Output Points for Rainfall and Discharge  ---
1200 DATA 1,3,7,10,13,17,20,23,25,29,32,35,38,41,45,48,51,54,57,60,64
1201 '
1202 '*****   Computation Condition   *****
1203 FOR ID = 1 TO NS
1204 CROA(ID) = FD(ID) / SA(ID):        '* Denuded Area Ratio
1205 NEXT ID
1206 '
1207 FOR JC = 1 TO NS
1208 RC(JC) = 0
1209 RC(JC) = (CRF * FL(JC) + CRG * FG(JC) + CRD * FD(JC)) / SA(JC): '* Runoff Ratio in the Mountain Area
1210 NEXT JC
1211 '
1220 '
1221 '***********  COMPUTATION OF CRITICAL DISCHARGE FOR BED LOAD  ***********
1222 FOR I = 1 TO NS
1223 IF DA(I) >= .303 THEN [illegible]
1224 IF DA(I) >= .118 THEN [illegible]
1225 IF DA(I) >= .0565 THEN [illegible]
1226 IF DA(I) >= .0065 THEN [illegible]
1227 UC(I) = 226 * DA(I): GOTO [illegible]
1228 UC(I) = 80.9 * DA(I): GOTO [illegible]
1229 UC(I) = 134.6 * (DA(I) ^ ([illegible] / 22)): GOTO [illegible]
1230 UC(I) = 55 * DA(I): GOTO [illegible]
1231 UC(I) = 8.41 * (DA(I) ^ ([illegible] / 32)): GOTO [illegible]
1232 HC(I) = UC(I) / (980 * [illegible])
1233 QCA(I) = 2 * (HC(I) ^ (5 / 3)) * SQR(VI(I)) / SN(I)
1234 NEXT I
1261 '***********  FILE INPUT AND DATA SELECTION FOR RAIN AND DISCHARGE  ************
1262 CLS : LOCATE 10, 15: PRINT " !!!!!  DATA FILE READING  !!!!!"
1263 'CLS
1265 DFILE$ = "A:CHAM862" + FI$ + ".DAT"
1270 OPEN DFILE$ FOR INPUT AS #1
1280 INPUT #1, A$, B$: ' PRINT CHR$(12); A$, B$
1290 INPUT #1, ICASE, FYR, FMS, FDY, FTH, ISTP, INN  'PRINT ISTP, INN
1291 FOR J = 1 TO INN
1292 INPUT #1, PNAM$: ' PRINT PNAM$
1293 FOR I = 1 TO NS
1294 IC = I
1312 II = NNP(I)
1313 IF J = II THEN 1316
1315 NEXT I: GOTO 1347
1316 FOR K = 1 TO ISTP + 1
1317 INPUT #1, DUM(K)
1318 IF K <= N THEN R(IC, K) = DUM(K): 'PRINT USING "  ###.#"; R(IC, K);
1319 NEXT K
1320 INPUT #1, PNAM$: 'PRINT PNAM$
1322 FOR K1 = 1 TO ISTP + 1
1323 INPUT #1, DUM(K1)
1324 IF K1 <= N THEN Q(IC, K1) = DUM(K1): 'PRINT USING "  ###.#"; Q(IC, K1);
1325 NEXT K1
1326 J = J + 1
1327 GOTO 1350
1347 FOR X2 = 1 TO ISTP + 1
1348 INPUT #1, DUM(X2)
1349 NEXT X2
1350 NEXT J
1358 CLOSE #1
```

粗度

浸食深さ可能深

定数は、これを与えている。

$Vc = 226 \times DA(I)$
$80.9 \times$
$134.6 \times$
$55 \times$
$8.41 \times (DA(I))^{11/32}$
$Hc = \frac{Vc}{980 \times I}$
$QCA(I) = 2 \times Hc^{5/3} \times \frac{\sqrt{I}}{n}$

$$EV = \frac{476\, Ca\, Ce}{d}\, q^{15/8} \cdot L^{3/8} \cdot S_0^{3/2}$$ ... Eroded Sediment Volume ($m^3/s/m^2$)

$q = 2.778 \times 10^{-7} \times f \cdot i$ ... inflow discharge on a slope

Ca ... areal ratio of denuded land.

10.4 $= \begin{cases} Ce = 0.17\, Cm \dfrac{(1+3.67 Rd)}{Cr/Pr} & ; Cr/Pr > 0.0425 \\ Ce = 4 Cm\, (1+3.67 Rd) & ; Cr/Pr \leqq 0.0425 \end{cases}$

... erodability coeficient

Cm ... Compaction efficiency of soil

cultivated area $Cm = 1.5$
compacted soil $Cm = 1.0$
cut slope soil $Cm = 0.5$

Cr ..

```
1360   CLS : LOCATE 10, 15: PRINT "!!!!!!! FILE READING IS COMPLETED !!!!!!!"
1430   '--- ACCMULATED RAINFALL ---
1440   FOR IO = 1 TO NS: SR(IO) = 0
1450   NEXT IO
1460   FOR I = 1 TO NS
1470   FOR J = 1 TO N
1480   SR(I) = SR(I) + R(I, J)
1490   RR(I, J) = SR(I)
1500   NEXT J: NEXT I
1505   '
1510   '--- ACCUMULATED DISCHARGE ---
1511   FOR K = 1 TO NS
1512   SQQ(K) = 0
1513   FOR L = 1 TO N
1514   SQQ(K) = SQQ(K) + Q(K, L) * 3600
1515   NEXT L: NEXT K
1516   CLS : LOCATE 10, 15: PRINT " >>>>>> COMPUTATION IS STARTED >>>>>>"
1519   '*************************************************************
1520   '****** COMPUTATION OF SEDIMENT PRODUCTION                ***
1530   '*************************************************************
1540   FOR IK = 1 TO NS
1550   LET SOS(IK) = 0: SQE(IK) = 0: SQF(IK) = 0: SQT(IK) = 0
1560   NEXT IK
1570   FOR I = 1 TO NS
1580   '+++++ Slope Erosion +++++
1590   ER1 = 476
1600   ER2 = ROA(I) * CE(I) / DHH(I)
1610   ER3 = (UL(I) ^ .375) * (UI(I) ^ 1.5)
1620   ERTS = ER1 * ER2 * ER3 * ((SAE(I) + SAF(I) / 2) * (10 ^ 6))
1630   FOR J = 1 TO N
1640   ERS = ERTS * (((2.228 * .8 * R(I, J) / (10 ^ 7)) ^ (1.875))
1650   QE(I, J) = ERS * 3600
1660   SQE(I) = SQE(I) + QE(I, J)
1670   NEXT J
1680   '+++++ Slope failure +++++
1690   FR1 = CG(I) * (SAF(I) / 10)
1700   FOR JJ = 1 TO N
1705   HAN = RR(I, JJ) - RN(I)
1707   IF HAN <= 0 THEN 1745
1710   IF JJ > 1 THEN 1740
1720   FRF(I, JJ) = FR1 * ((RR(I, JJ) - RN(I)) ^ 2)
1730   GOTO 1750
1740   FRF(I, JJ) = FR1 * ((RR(I, JJ) - RN(I)) ^ 2) - FRF(I, JJ - 1)
1742   GOTO 1750
1745   QF(I, JJ) = 0: GOTO 1760
1750   QF(I, JJ) = FRF(I, JJ) * AD(I)
1760   SQF(I) = SQF(I) + QF(I, JJ)
1770   NEXT JJ
1780   '+++++ Torrent +++++
1790   TO1 = 1361.2
1795   TI(I) = (1 / 3.5) * TI(I)
1800   TO2 = (TI(I) ^ 1.75) * (SN(I) ^ 1.5) / (DH(I) / 10)
1810   FOR JK = 1 TO N
1812   QTK = Q(I, JK) * TO(I) / TTO(I)
1813   IF QTK < QCA(I) THEN 1815 ELSE 1820
1815   QT(I, JK) = 0: GOTO 1840
1820   FQA = QTK / QCA(I)
1825   TOO = FQA * TO1 * TO2 * (QCA(I) ^ 1.25)
1830   QT(I, JK) = TOO * 3600 * ROA(I)
1840   SQT(I) = SQT(I) + QT(I, JK)
1850   NEXT JK
1860   '+++++ Total Sediment Production +++++
1870   FOR JT = 1 TO N
1880   QS(I, JT) = QE(I, JT) + QF(I, JT) + QT(I, JT)
1890   SOS(I) = SOS(I) + QS(I, JT)
1900   NEXT JT
1910   SUMQ = SQE(I) + SQF(I) + SQT(I)
1920   'IF SOS(I) = SUMQ THEN PRINT "OK !!!!!" ELSE STOP
1930   NEXT I
1935   CLS : LOCATE 10, 15: PRINT ">>>>>>>>> COMPUTATION IS COMPLETED !!!!"
1936   '
1937   LPRINT CHR$(12)
1938   IF PT$ = "G" THEN PF$ = " ***** 100-YEAR FLOOD ***** "
1939   IF PT$ = "H" THEN PF$ = " *****  50-YEAR FLOOD ***** "
1940   IF PT$ = "I" THEN PF$ = " *****  30-YEAR FLOOD ***** "
1941   IF PT$ = "J" THEN PF$ = " *****  10-YEAR FLOOD ***** "
1942   IF PT$ = "K" THEN PF$ = " *****   5-YEAR FLOOD ***** "
1943   IF PT$ = "L" THEN PF$ = " *****   2-YEAR FLOOD ***** "
1946   '
1960   IF P$ = "N" THEN 2341
1968   '*************************************************************
1969   '***           PRINTOUT OF COMPUTATION RESULTS           ***
1970   '*************************************************************
1980   '---------- Dimension and Constant of Subbasin ------------
1990   'LPRINT CHR$(12)
2000   FOR II = 1 TO NS
2010   BSN$(II) = "SUB" + MID$(SBR$(II), 2, 3)
2020   NEXT II
2030   LPRINT TAB(10); "*******  OUTPUT OF COMPUTATION CONDITION  ***********"
2040   LPRINT
2050   '
2060   LPRINT TAB(7); " Basin  Runoff  Mean  50 %  ARMOUR  MOUNT  **** Land Use **** Denuded *** Unit Slope ***  Eroda- Relief Non-ef  Coeff. Fa
2070   LPRINT " ** Torrent *  Rough. Possibl"
2080   LPRINT TAB(7); "  Area  Ratio  Size  Size   SIZE   SIZE Forest  Grass Denude Ratio  Length  Width Grad't bility  Ratio  Rain  of G   D
2090   LPRINT "Density Grad't Coeff. Depth"
2095   LPRINT "--------------------------------------------------------------------------------------------------------"
2100   FOR IL = 1 TO NS
2110   LPRINT USING "    ## ####.#  #.## "; IL; SA(IL); RC(IL);
2130   LPRINT USING " ###.# "; DH(IL); DSO(IL); DA(IL); DM(IL); FL(IL); FG(IL); FD(IL);
2140   LPRINT USING " #.##  "; ROA(IL);
2150   LPRINT USING " ##### "; UL(IL); UB(IL);
2155   LPRINT USING " #.### "; UI(IL);
2160   LPRINT USING " ###.##"; CE(IL); XRR(IL);
2165   LPRINT USING " ###.#."; RN(IL);
2170   LPRINT USING " #.#   "; CG(IL);
2175   LPRINT USING "  ##.# "; AD(IL);
2180   LPRINT USING " ##### #.### "; TO(IL); TI(IL);
2182   LPRINT USING " #.###   ##.# "; SN(IL); PDI(IL)
2185   NEXT IL
2190   '
2200   '
2220   '---------- Results of Computation ----------------
2275   LPRINT CHR$(12)
2277   '
2278   'LPRINT "   "; PF$
2280   LPRINT TAB(10); "**********  OUTPUT OF COMPUTATION RESULS  ***********"
2290   '
2300   FOR I = 1 TO NS
2310   CHAN = (I / 3) - INT(I / 3)
2320   IF CHAN = 0 THEN IRP = I - 2 ELSE 2340
2330   GOSUB 3000
2340   NEXT I
2341   LPRINT "   "; PF$
2343   LPRINT "   **************  TOTAL SEDIMENT PRODUCTION VOLUME  ************"
2344   LPRINT : LPRINT "      ??? EROSION ???  ??? FAILURE ???  ??? TORRENT ???   ??? TOTAL  ???   ??? DISCHARGE ???"
2345   FOR IA = 1 TO NS
2346   LPRINT USING " ## "; IA;
2347   LPRINT USING "    #.####     "; SQE(IA), SOF(IA), SQT(IA), SOS(IA), SQQ(IA)
```

476

$ER2 = \frac{Ca \times Ce}{d}$

$c^{3/8} \times S_0^{3/2}$

$(\delta^{15/8}) = (2.228 \times 10^{-7} \times f \times i)^{15/8}$

?

P112

EV

別に計算して与えている。その他の定数も同様に。読み込んでいるのは R(I,J) 雨量のみ

DBが出して まったく新たにデータを入れ計算することはできるのか

```
2348 └─NEXT IA
2350   '--------- Sediment Production for Each Category '-----------
2360   TQS = 0: BQE = 0: BQF = 0: BQT = 0:  TQ = 0
2370 ┌─FOR J = 1 TO NS
2380 │ BQE = BQE + SQE(J)
2390 │ BQF = BQF + SQF(J)
2400 │ BQT = BQT + SQT(J)
2410 │ TQ = TQ + SQQ(J)
2420 └─NEXT J
2430   TQS = BQE + BQF + BQT
2440   '-------- Printout of Total Volume -----------
2450   LPRINT
2460   LPRINT "-----------------------------------------------------------------"
2470   LPRINT "TOTAL";
2480   LPRINT USING "    #.####^^^^   "; BQE, BQF, BQT, TQS, TQ
2490   LPRINT
2492   LPRINT "TOTAL SEDIMENT PRODUCTION =";
2495   LPRINT USING " #.##      "; TQS
2500   '
2505   IF HS$ = "N" THEN 2900
2510   '************** PRODUCTION AND DISCHARGE OF WASH LOAD *************
2520   '
2530   '------------ Computation of Wash Load ------------
2535 ┌──FOR I = 1 TO NS
2540 │  ET1(I) = 0: ET2(I) = 0: ET3(I) = 0
2545 │ ┌FOR J = 1 TO NS
2550 │ │ E1(I, J) = 3.34 * ((Q(I, J) / SA(I)) ^ 1.39) * 3600 / (10 ^ 7)
2555 │ │ E2(I, J) = 1.86 * ((Q(I, J) / SA(I)) ^ 2.29) * 3600 / (10 ^ 6)
2560 │ │ E3(I, J) = 1.15 * ((Q(I, J) / SA(I)) ^ 2.9) * 3600 / (10 ^ 6)
2565 │ │ ET1(I) = E1(I, J) + ET1(I)
2570 │ │ ET2(I) = E2(I, J) + ET2(I)
2580 │ │ ET3(I) = E3(I, J) + ET3(I)
2585 │ └NEXT J
2586 └──NEXT I
2590   '
2595   '------------- Output of Wash Load Computation -------------
2600   LPRINT CHR$(12)
2610   LPRINT " ****************** PRINTOUT OF WASH LOAD COMPUTATION ********************"
2615   LPRINT "  NUDEO AREA 0-ORDER VALLEY 1-ORDER VALLEY "
2620 ┌─LPRINT "-------------------------------------------"
2622 │ FOR II = 1 TO NS
2625 │ LPRINT USING "    #.###^^^^      "; ET1(II), ET2(II), ET3(II)
2630 └─NEXT II
2900   END
3000   '********** SUBROUTINE : Output for Every 3 Subbasins ************
3010   '
3020   LPRINT CHR$(12)
3025 ┌─FOR IRN = IRP TO IRP + 2
3030 │ PBN$(IRN) = "Sub-Basin " + MID$(STR$(IRN), 2, 3)
3040 └─NEXT IRN
3050   LPRINT TAB(26); PBN$(IRP); TAB(75); PBN$(IRP + 1); TAB(121); PBN$(IRP + 2)
3055   LPRINT "------------------------------------------------------------------------------------------------------------------------"
3060   LPRINT " Time";
3070 ┌─FOR NP = 1 TO 3
3080 │ LPRINT "    R    RR     Q      QE          QF          QT   ";
3090 └─NEXT NP
3100   LPRINT "------------------------------------------------------------------------------------------------------------------------"
3110 ┌─FOR IP = 1 TO N
3120 │ CHHA = (IP / 40) - INT(IP / 40)
3130 │ IF CHHA = 0 THEN GOSUB 4000 ELSE 3140
3140 │ LPRINT USING "  ## "; IP;
3145 │ LPRINT USING " ###.#"; R(IRP, IP); RR(IRP, IP);
3150 │ LPRINT USING " ###.#::.Q(IRP, IP);
3160 │ LPRINT USING " #.##        "; QE(IRP, IP), QF(IRP, IP), QT(IRP, IP);
3161 │ LPRINT USING " ###.#"; R(IRP + 1, IP), RR(IRP + 1, IP);
3162 │ LPRINT USING " ###.#::.Q(IRP + 1, IP);
3163 │ LPRINT USING " #.##        "; QE(IRP + 1, IP), QF(IRP + 1, IP), QT(IRP + 1, IP);
3164 │ LPRINT USING " ###.#"; R(IRP + 2, IP), RR(IRP + 2, IP);
3165 │ LPRINT USING " ###.#::.Q(IRP + 2, IP);
3166 │ LPRINT USING " #.##        "; QE(IRP + 2, IP), QF(IRP + 2, IP), QT(IRP + 2, IP)
3170 └─NEXT IP
3180   RETURN
4000   '------------- SUBROUTINE : Page feeding ---------------
4005   LPRINT CHR$(12)
4010   LPRINT TAB(26); PBN$(IRP); TAB(75); PBN$(IRP + 1); TAB(121); PBN$(IRP + 2)
4015   LPRINT "------------------------------------------------------------------------------------------------------------------------"
4020   LPRINT " Time";
4030 ┌─FOR NIP = 1 TO 3
4040 │ LPRINT "    R    RR     Q      QE          QF          QT   ";
4050 └─NEXT NIP
4055   LPRINT "------------------------------------------------------------------------------------------------------------------------"
4060   LPRINT
4070   RETURN
```

Wash load ?

******* OUTPUT OF COMPUTATION CONDITION **********

Basin	Area (Km²)	Runoff Ratio	Mean Size (mm)	50 % Size (mm)	ARMOUR SIZE (cm)	MOUNT SIZE	**** Land Use **** Forest (Km²)	Grass (Km²)	Denude (Km²)	Denuded Ratio	*** Unit Slope *** Length (m)	Width (m)	Grad't	Erodability	Relief Ratio	Non-ef Rain (mm)	Coeff. of G	Failure Depth (m)	** Torrent * Density (m/Km²)	Grad't	Rough. Coeff.	Possibl Depth (m)
1	365.0	0.59	116.0	118.0	11.8	1.0	14.7	350.3	0.0	0.00	100	2035	0.674	10.40	1.00	50.0	0.5E+01	2.0	1684	0.193	0.050	1.0
2	134.2	0.45	73.0	32.0	3.2	1.0	116.6	22.6	0.0	0.00	100	2343	0.732	10.40	1.00	50.0	0.5E+01	2.0	1344	0.209	0.050	1.0
3	102.4	0.54	168.0	200.0	2.0	1.0	28.6	73.8	0.0	0.00	100	4453	0.874	10.40	1.00	50.0	0.5E+01	10.0	3242	0.250	0.050	1.0
4	205.7	0.49	107.0	58.0	5.8	1.0	112.6	93.1	0.0	0.00	100	1141	0.772	10.40	1.00	50.0	0.5E+01	5.0	1625	0.221	0.050	1.0
5	192.7	0.44	46.0	25.0	2.5	1.0	149.8	42.9	0.0	0.00	100	1180	0.734	10.40	1.00	50.0	0.5E+01	2.0	961	0.210	0.050	1.0
6	130.0	0.43	46.0	25.0	2.5	1.0	109.1	20.9	0.0	0.00	100	2320	0.736	10.40	1.00	50.0	0.5E+01	2.0	1820	0.210	0.050	1.0
7	98.0	0.42	67.0	34.0	3.4	1.0	93.8	0.5	3.6	0.04	100	3203	0.518	10.40	1.00	50.0	0.5E+01	5.0	1766	0.148	0.050	1.0
8	304.8	0.43	32.0	14.0	1.4	1.0	265.9	34.8	4.1	0.01	100	2031	0.760	10.40	1.00	20.0	0.5E+01	5.0	1705	0.217	0.050	1.0
9	338.0	0.44	50.0	39.0	1.4	1.0	292.5	30.4	15.1	0.04	100	2012	0.790	10.40	1.00	20.0	0.5E+01	2.0	2008	0.226	0.050	1.0
10	118.6	0.44	125.0	130.0	13.0	1.0	103.4	8.7	6.5	0.05	100	2238	0.570	10.40	1.00	50.0	0.5E+01	5.0	1520	0.163	0.050	1.0
11	63.2	0.43	125.0	130.0	13.0	1.0	58.5	0.0	4.7	0.07	100	1844	0.352	10.40	1.00	50.0	0.5E+02	5.0	1344	0.103	0.050	1.0
12	58.8	0.51	22.0	12.0	1.2	1.0	42.8	0.0	16.0	0.27	100	2328	0.595	10.40	1.00	20.0	0.5E+01	2.0	2016	0.170	0.050	1.0
13	136.6	0.43	22.0	12.0	1.2	1.0	120.1	11.9	4.6	0.03	100	3328	0.716	10.40	1.00	20.0	0.5E+01	2.0	2797	0.205	0.050	1.0
14	191.5	0.55	22.0	12.0	1.2	1.0	119.0	0.0	72.5	0.38	100	953	0.794	10.40	1.00	20.0	0.5E+01	5.0	508	0.227	0.050	1.0
15	45.4	0.55	22.0	12.0	1.2	1.0	28.5	0.0	16.9	0.37	100	1797	0.602	10.40	1.00	20.0	0.5E+01	2.0	1563	0.172	0.050	1.0
16	270.7	0.43	22.0	12.0	12.0	1.0	252.9	0.0	17.8	0.07	100	2984	0.756	10.40	1.00	50.0	0.5E+01	2.0	2715	0.219	0.050	1.0
17	74.7	0.44	22.0	12.0	12.0	1.0	67.6	0.0	7.1	0.10	100	2000	0.720	10.40	1.00	50.0	0.5E+01	2.0	1594	0.206	0.050	1.0
18	241.0	0.40	28.0	21.0	21.0	1.0	241.0	0.0	0.0	0.00	100	1609	0.880	10.40	1.00	50.0	0.5E+01	2.0	1344	0.251	0.050	1.0
19	173.5	0.40	28.0	21.0	21.0	1.0	173.5	0.0	0.0	0.00	100	2219	0.536	10.40	1.00	50.0	0.5E+01	2.0	1766	0.153	0.050	1.0
20	119.9	0.40	28.0	21.0	2.1	1.0	119.9	0.0	0.0	0.00	100	1219	0.752	10.40	1.00	50.0	0.5E+01	2.0	742	0.215	0.050	1.0
21	152.3	0.40	19.0	13.0	1.3	1.0	152.3	0.0	0.0	0.00	100	1328	0.308	10.40	1.00	50.0	0.5E+01	2.0	984	0.088	0.050	1.0

コンソールからの入力データ

Printout of Hourly --- Y

Number of Subbasin 21

Number of Computation Steps 24

Compute Wash Load -- Y

Probability - 1

*********** OUTPUT OF COMPUTATION RESULS ***********

	Sub-Basin 1						Sub-Basin 2						Sub-Basin 3					
Time	R	RR	Q	QE	QF	QT	R	RR	Q	QE	QF	QT	R	RR	Q	QE	QF	QT
1	0.0	0.0	9.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.6	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.7	0.00E+00	0.00E+00	0.00E+00
2	0.0	0.0	9.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.6	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.7	0.00E+00	0.00E+00	0.00E+00
3	0.0	0.0	9.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.6	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.7	0.00E+00	0.00E+00	0.00E+00
4	0.0	0.0	9.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.6	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.7	0.00E+00	0.00E+00	0.00E+00
5	0.0	0.0	9.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.6	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.7	0.00E+00	0.00E+00	0.00E+00
6	0.0	0.0	9.7	0.00E+00	0.00E+00	0.00E+00	0.6	0.5	3.6	0.00E+00	0.00E+00	0.00E+00	0.3	0.3	2.7	0.00E+00	0.00E+00	0.00E+00
7	0.0	0.0	9.7	0.00E+00	0.00E+00	0.00E+00	0.1	0.8	3.6	0.00E+00	0.00E+00	0.00E+00	0.1	0.4	2.7	0.00E+00	0.00E+00	0.00E+00
8	1.9	1.9	9.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.8	3.6	0.00E+00	0.00E+00	0.00E+00	0.0	0.4	2.7	0.00E+00	0.00E+00	0.00E+00
9	0.5	2.3	10.0	0.00E+00	0.00E+00	0.00E+00	3.7	4.5	3.7	0.00E+00	0.00E+00	0.00E+00	1.9	2.2	2.7	0.00E+00	0.00E+00	0.00E+00
10	0.5	2.8	10.3	0.00E+00	0.00E+00	0.00E+00	0.4	4.9	3.8	0.00E+00	0.00E+00	0.00E+00	0.2	2.4	2.7	0.00E+00	0.00E+00	0.00E+00
11	0.0	2.8	10.7	0.00E+00	0.00E+00	0.00E+00	0.0	4.9	3.8	0.00E+00	0.00E+00	0.00E+00	0.0	2.4	2.7	0.00E+00	0.00E+00	0.00E+00
12	0.0	2.8	10.7	0.00E+00	0.00E+00	0.00E+00	0.0	4.9	3.8	0.00E+00	0.00E+00	0.00E+00	0.0	2.4	2.7	0.00E+00	0.00E+00	0.00E+00
13	0.0	2.8	10.7	0.00E+00	0.00E+00	0.00E+00	0.1	5.0	3.8	0.00E+00	0.00E+00	0.00E+00	0.1	2.5	2.7	0.00E+00	0.00E+00	0.00E+00
14	0.0	2.8	10.6	0.00E+00	0.00E+00	0.00E+00	0.1	5.1	3.8	0.00E+00	0.00E+00	0.00E+00	0.1	2.5	2.7	0.00E+00	0.00E+00	0.00E+00
15	0.0	2.8	10.6	0.00E+00	0.00E+00	0.00E+00	10.6	15.7	20.9	0.00E+00	0.00E+00	0.00E+00	5.3	7.9	4.3	0.00E+00	0.00E+00	0.00E+00
16	0.0	2.8	10.6	0.00E+00	0.00E+00	0.00E+00	2.0	17.8	26.8	0.00E+00	0.00E+00	0.00E+00	1.0	8.9	5.7	0.00E+00	0.00E+00	0.00E+00
17	10.8	13.6	10.6	0.00E+00	0.00E+00	0.00E+00	7.8	25.6	80.1	0.00E+00	0.00E+00	0.00E+00	3.9	12.8	11.5	0.00E+00	0.00E+00	0.00E+00
18	0.0	13.6	102.6	0.00E+00	0.00E+00	0.00E+00	6.9	32.5	122.9	0.00E+00	0.00E+00	0.00E+00	3.5	16.2	21.2	0.00E+00	0.00E+00	0.00E+00
19	0.0	13.6	77.4	0.00E+00	0.00E+00	0.00E+00	3.2	35.7	95.5	0.00E+00	0.00E+00	0.00E+00	1.6	17.8	25.4	0.00E+00	0.00E+00	0.00E+00
20	0.0	13.6	61.3	0.00E+00	0.00E+00	0.00E+00	0.0	35.7	53.8	0.00E+00	0.00E+00	0.00E+00	0.0	17.8	21.6	0.00E+00	0.00E+00	0.00E+00
21	0.0	13.6	50.8	0.00E+00	0.00E+00	0.00E+00	0.0	35.7	37.1	0.00E+00	0.00E+00	0.00E+00	0.0	17.8	17.3	0.00E+00	0.00E+00	0.00E+00
22	0.0	13.6	43.4	0.00E+00	0.00E+00	0.00E+00	0.0	35.7	28.3	0.00E+00	0.00E+00	0.00E+00	0.0	17.8	14.5	0.00E+00	0.00E+00	0.00E+00
23	0.0	13.6	38.0	0.00E+00	0.00E+00	0.00E+00	0.0	35.7	22.9	0.00E+00	0.00E+00	0.00E+00	0.0	17.8	12.4	0.00E+00	0.00E+00	0.00E+00
24	0.0	13.6	33.9	0.00E+00	0.00E+00	0.00E+00	0.0	35.7	19.3	0.00E+00	0.00E+00	0.00E+00	0.0	17.8	11.0	0.00E+00	0.00E+00	0.00E+00

	Sub-Basin 4						Sub-Basin 5						Sub-Basin 6					
Time	R	RR	Q	QE	QF	QT	R	RR	Q	QE	QF	QT	R	RR	Q	QE	QF	QT
1	0.0	0.0	5.5	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	5.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.5	0.00E+00	0.00E+00	0.00E+00
2	0.0	0.0	5.5	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	5.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.5	0.00E+00	0.00E+00	0.00E+00
3	0.0	0.0	5.5	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	5.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.5	0.00E+00	0.00E+00	0.00E+00
4	0.0	0.0	5.5	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	5.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.5	0.00E+00	0.00E+00	0.00E+00
5	0.0	0.0	5.5	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	5.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.5	0.00E+00	0.00E+00	0.00E+00
6	0.6	0.6	5.5	0.00E+00	0.00E+00	0.00E+00	0.9	0.9	5.1	0.00E+00	0.00E+00	0.00E+00	0.6	0.6	3.5	0.00E+00	0.00E+00	0.00E+00
7	0.1	0.7	5.5	0.00E+00	0.00E+00	0.00E+00	0.2	1.1	5.1	0.00E+00	0.00E+00	0.00E+00	0.1	0.7	3.5	0.00E+00	0.00E+00	0.00E+00
8	0.0	0.7	5.5	0.00E+00	0.00E+00	0.00E+00	0.0	1.1	5.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.7	3.5	0.00E+00	0.00E+00	0.00E+00
9	3.5	4.2	5.6	0.00E+00	0.00E+00	0.00E+00	5.3	6.4	5.8	0.00E+00	0.00E+00	0.00E+00	3.6	4.3	3.6	0.00E+00	0.00E+00	0.00E+00
10	0.4	4.6	6.4	0.00E+00	0.00E+00	0.00E+00	0.5	5.9	6.0	0.00E+00	0.00E+00	0.00E+00	0.4	4.7	4.0	0.00E+00	0.00E+00	0.00E+00
11	0.0	4.6	6.7	0.00E+00	0.00E+00	0.00E+00	0.0	6.9	6.0	0.00E+00	0.00E+00	0.00E+00	0.0	4.7	4.2	0.00E+00	0.00E+00	0.00E+00
12	0.0	4.6	6.6	0.00E+00	0.00E+00	0.00E+00	0.0	6.9	6.0	0.00E+00	0.00E+00	0.00E+00	0.0	4.7	4.1	0.00E+00	0.00E+00	0.00E+00
13	0.1	4.7	6.6	0.00E+00	0.00E+00	0.00E+00	0.2	7.1	6.1	0.00E+00	0.00E+00	0.00E+00	0.1	4.8	4.1	0.00E+00	0.00E+00	0.00E+00
14	0.1	4.8	6.7	0.00E+00	0.00E+00	0.00E+00	0.2	7.3	6.2	0.00E+00	0.00E+00	0.00E+00	0.1	4.9	4.2	0.00E+00	0.00E+00	0.00E+00
15	10.0	14.8	13.3	0.00E+00	0.00E+00	0.00E+00	15.1	22.4	91.4	0.00E+00	0.00E+00	0.00E+00	10.3	15.2	11.4	0.00E+00	0.00E+00	0.00E+00
16	1.9	16.7	54.5	0.00E+00	0.00E+00	0.00E+00	2.9	25.3	94.4	0.00E+00	0.00E+00	0.00E+00	2.0	17.2	34.9	0.00E+00	0.00E+00	0.00E+00
17	7.3	24.0	70.4	0.00E+00	0.00E+00	0.00E+00	11.1	36.4	250.6	0.00E+00	0.00E+00	0.00E+00	7.6	24.8	50.7	0.00E+00	0.00E+00	0.00E+00
18	6.5	30.5	147.0	0.00E+00	0.00E+00	0.00E+00	9.8	46.2	304.7	0.00E+00	0.00E+00	0.00E+00	6.7	31.5	99.6	0.00E+00	0.00E+00	0.00E+00
19	3.0	33.5	182.6	0.00E+00	0.00E+00	0.00E+00	4.6	50.8	193.1	0.00E+00	0.79E+01	0.00E+00	3.1	34.6	116.8	0.00E+00	0.00E+00	0.00E+00
20	0.0	33.5	135.0	0.00E+00	0.00E+00	0.00E+00	0.0	50.8	92.7	0.00E+00	0.00E+00	0.00E+00	0.0	34.6	83.7	0.00E+00	0.00E+00	0.00E+00
21	0.0	33.5	78.0	0.00E+00	0.00E+00	0.00E+00	0.0	50.8	60.4	0.00E+00	0.79E+01	0.00E+00	0.0	34.6	48.5	0.00E+00	0.00E+00	0.00E+00
22	0.0	33.5	54.1	0.00E+00	0.00E+00	0.00E+00	0.0	50.8	44.6	0.00E+00	0.00E+00	0.00E+00	0.0	34.6	33.8	0.00E+00	0.00E+00	0.00E+00
23	0.0	33.5	41.2	0.00E+00	0.00E+00	0.00E+00	0.0	50.8	35.4	0.00E+00	0.79E+01	0.00E+00	0.0	34.6	25.8	0.00E+00	0.00E+00	0.00E+00
24	0.0	33.5	33.2	0.00E+00	0.00E+00	0.00E+00	0.0	50.8	29.4	0.00E+00	0.00E+00	0.00E+00	0.0	34.6	20.9	0.00E+00	0.00E+00	0.00E+00

Time	Sub-Basin 7 R	RR	Q	QE	QF	QT	Sub-Basin 8 R	RR	Q	QE	QF	QT	Sub-Basin 9 R	RR	Q	QE	QF	QT
1	0.0	0.0	2.6	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	8.1	0.00E+00	0.00E+00	0.12E+03	0.0	0.0	9.0	0.00E+00	0.00E+00	0.30E+03
2	0.0	0.0	2.6	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	8.1	0.00E+00	0.00E+00	0.12E+03	0.0	0.0	9.0	0.00E+00	0.00E+00	0.30E+03
3	0.0	0.0	2.6	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	8.1	0.00E+00	0.00E+00	0.12E+03	0.0	0.0	9.0	0.00E+00	0.00E+00	0.30E+03
4	0.0	0.0	2.6	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	8.1	0.00E+00	0.00E+00	0.12E+03	0.0	0.0	9.0	0.00E+00	0.00E+00	0.30E+03
5	0.0	0.0	2.5	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	8.1	0.00E+00	0.00E+00	0.12E+03	0.0	0.0	9.0	0.00E+00	0.00E+00	0.30E+03
6	0.7	0.7	2.5	0.12E+02	0.00E+00	0.00E+00	0.0	0.0	8.1	0.00E+00	0.00E+00	0.12E+03	0.5	0.5	9.0	0.25E+03	0.00E+00	0.30E+03
7	0.1	0.8	2.6	0.53E+00	0.00E+00	0.00E+00	0.0	0.0	8.1	0.00E+00	0.00E+00	0.12E+03	0.1	0.8	9.0	0.78E+01	0.00E+00	0.30E+03
8	0.0	0.8	2.6	0.00E+00	0.00E+00	0.00E+00	1.5	1.5	8.1	0.19E+03	0.00E+00	0.12E+03	0.0	0.8	9.0	0.00E+00	0.00E+00	0.30E+03
9	4.0	4.8	2.7	0.34E+03	0.00E+00	0.00E+00	0.4	1.9	8.1	0.14E+02	0.00E+00	0.12E+03	3.7	4.5	9.4	0.42E+04	0.00E+00	0.31E+03
10	0.4	5.2	2.8	0.48E+01	0.00E+00	0.00E+00	0.4	2.3	8.1	0.14E+02	0.00E+00	0.12E+03	0.4	4.9	10.6	0.58E+02	0.00E+00	0.35E+03
11	0.0	5.2	2.8	0.00E+00	0.00E+00	0.00E+00	0.0	2.3	8.2	0.00E+00	0.00E+00	0.12E+03	0.0	4.9	10.9	0.00E+00	0.00E+00	0.36E+03
12	0.0	5.2	2.8	0.00E+00	0.00E+00	0.00E+00	0.0	2.3	8.3	0.00E+00	0.00E+00	0.12E+03	0.0	4.9	10.9	0.00E+00	0.00E+00	0.36E+03
13	0.1	5.3	2.8	0.63E+00	0.00E+00	0.00E+00	0.0	2.3	8.3	0.00E+00	0.00E+00	0.12E+03	0.1	5.0	10.9	0.78E+01	0.00E+00	0.36E+03
14	0.1	5.5	2.8	0.63E+00	0.00E+00	0.00E+00	0.0	2.3	8.3	0.00E+00	0.00E+00	0.12E+03	0.1	5.1	11.0	0.78E+01	0.00E+00	0.36E+03
15	11.4	16.8	20.3	0.24E+04	0.00E+00	0.21E+03	0.0	2.3	8.3	0.00E+00	0.00E+00	0.12E+03	10.6	15.7	31.9	0.30E+05	0.00E+00	0.11E+04
16	2.2	19.0	25.0	0.11E+03	0.00E+00	0.26E+03	0.0	2.3	8.3	0.00E+00	0.00E+00	0.12E+03	2.0	17.8	99.8	0.14E+04	0.00E+00	0.33E+04
17	8.4	27.4	72.2	0.14E+04	0.00E+00	0.76E+03	8.7	11.0	8.3	0.51E+04	0.00E+00	0.12E+03	7.8	25.6	143.0	0.17E+05	0.00E+00	0.47E+04
18	7.4	34.8	104.2	0.11E+04	0.00E+00	0.11E+04	0.0	11.0	11.8	0.00E+00	0.00E+00	0.17E+03	6.9	32.5	278.9	0.13E+05	0.00E+00	0.92E+04
19	3.4	38.2	76.9	0.25E+03	0.00E+00	0.81E+03	0.0	11.0	36.8	0.00E+00	0.00E+00	0.54E+03	3.2	35.7	323.0	0.32E+04	0.00E+00	0.11E+05
20	0.0	38.2	41.7	0.00E+00	0.00E+00	0.44E+03	0.0	11.0	32.3	0.00E+00	0.00E+00	0.48E+03	0.0	35.7	227.9	0.00E+00	0.00E+00	0.75E+04
21	0.0	38.2	28.3	0.00E+00	0.00E+00	0.30E+03	0.0	11.0	28.9	0.00E+00	0.00E+00	0.43E+03	0.0	35.7	130.4	0.00E+00	0.00E+00	0.43E+04
22	0.0	38.2	21.4	0.00E+00	0.00E+00	0.22E+03	0.0	11.0	26.3	0.00E+00	0.00E+00	0.39E+03	0.0	35.7	90.2	0.00E+00	0.00E+00	0.30E+04
23	0.0	38.2	17.2	0.00E+00	0.00E+00	0.00E+00	0.0	11.0	24.2	0.00E+00	0.00E+00	0.36E+03	0.0	35.7	68.7	0.00E+00	0.00E+00	0.23E+04
24	0.0	38.2	14.4	0.00E+00	0.00E+00	0.00E+00	0.0	11.0	22.4	0.00E+00	0.00E+00	0.33E+03	0.0	35.7	55.4	0.00E+00	0.00E+00	0.18E+04

	Sub-Basin 10						Sub-Basin 11						Sub-Basin 12					
Time	R	RR	Q	QE	QF	QT	R	RR	Q	QE	QF	QT	R	RR	Q	QE	QF	QT
1	0.0	0.0	3.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.6	0.00E+00	0.00E+00	0.00E+00
2	0.0	0.0	3.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.6	0.00E+00	0.00E+00	0.00E+00
3	0.0	0.0	3.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.6	0.00E+00	0.00E+00	0.00E+00
4	0.0	0.0	3.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.6	0.00E+00	0.00E+00	0.00E+00
5	0.0	0.0	3.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.6	0.00E+00	0.00E+00	0.00E+00
6	0.0	0.0	3.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.6	0.00E+00	0.00E+00	0.00E+00
7	0.0	0.0	3.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.6	0.00E+00	0.00E+00	0.00E+00
8	0.0	0.0	3.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.5	0.00E+00	0.00E+00	0.00E+00
9	0.0	0.0	3.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.6	0.00E+00	0.00E+00	0.00E+00
10	0.0	0.0	3.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.6	0.00E+00	0.00E+00	0.00E+00
11	0.0	0.0	3.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.6	0.00E+00	0.00E+00	0.00E+00
12	0.0	0.0	3.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.6	0.00E+00	0.00E+00	0.00E+00
13	0.0	0.0	3.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.6	0.00E+00	0.00E+00	0.00E+00
14	0.0	0.0	3.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.6	0.00E+00	0.00E+00	0.00E+00
15	0.0	0.0	3.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.7	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	1.6	0.00E+00	0.00E+00	0.00E+00
16	1.0	1.0	3.1	0.53E+02	0.00E+00	0.00E+00	0.9	0.9	1.7	0.71E+00	0.00E+00	0.00E+00	0.0	0.0	1.6	0.00E+00	0.00E+00	0.00E+00
17	2.1	3.1	3.1	0.19E+03	0.00E+00	0.00E+00	1.9	2.8	1.7	0.26E+01	0.00E+00	0.00E+00	29.5	29.5	76.2	0.14E+06	0.00E+00	0.23E+05
18	2.6	5.7	3.4	0.29E+03	0.00E+00	0.00E+00	2.3	5.1	2.0	0.40E+01	0.00E+00	0.00E+00	24.9	54.4	257.5	0.10E+06	0.00E+00	0.75E+05
19	3.1	8.7	4.9	0.41E+03	0.00E+00	0.00E+00	2.8	7.9	3.0	0.56E+01	0.00E+00	0.00E+00	0.0	54.4	36.7	0.00E+00	0.00E+00	0.11E+05
20	1.0	9.8	8.6	0.53E+02	0.00E+00	0.00E+00	0.9	8.8	3.7	0.71E+00	0.00E+00	0.00E+00	0.0	54.4	22.4	0.00E+00	0.00E+00	0.55E+04
21	0.0	9.8	9.9	0.00E+00	0.00E+00	0.00E+00	0.0	8.8	3.7	0.00E+00	0.00E+00	0.00E+00	0.0	54.4	16.0	0.00E+00	0.00E+00	0.47E+04
22	0.5	10.3	9.3	0.14E+02	0.00E+00	0.00E+00	0.5	9.3	3.9	0.19E+00	0.00E+00	0.00E+00	0.0	54.4	12.4	0.00E+00	0.00E+00	0.37E+04
23	1.5	11.8	10.1	0.11E+03	0.00E+00	0.00E+00	1.4	10.7	4.9	0.15E+01	0.00E+00	0.00E+00	0.0	54.4	10.1	0.00E+00	0.00E+00	0.30E+04
24	0.0	11.8	12.7	0.00E+00	0.00E+00	0.00E+00	0.0	10.7	4.8	0.00E+00	0.00E+00	0.00E+00	0.0	54.4	8.6	0.00E+00	0.00E+00	0.25E+04

Time	Sub-Basin 13 R	RR	Q	QE	QF	QT	Sub-Basin 14 R	RR	Q	QE	QF	QT	Sub-Basin 15 R	RR	Q	QE	QF	QT
1	0.0	0.0	3.6	0.00E+00	0.00E+00	0.17E+03	0.0	0.0	5.1	0.00E+00	0.00E+00	0.20E+04	0.0	0.0	1.2	0.00E+00	0.00E+00	0.00E+00
2	0.0	0.0	3.6	0.00E+00	0.00E+00	0.17E+03	0.0	0.0	5.1	0.00E+00	0.00E+00	0.20E+04	0.0	0.0	1.2	0.00E+00	0.00E+00	0.00E+00
3	0.0	0.0	3.6	0.00E+00	0.00E+00	0.17E+03	0.0	0.0	5.1	0.00E+00	0.00E+00	0.20E+04	0.0	0.0	1.2	0.00E+00	0.00E+00	0.00E+00
4	0.0	0.0	3.6	0.00E+00	0.00E+00	0.17E+03	0.0	0.0	5.1	0.00E+00	0.00E+00	0.20E+04	0.0	0.0	1.2	0.00E+00	0.00E+00	0.00E+00
5	0.0	0.0	3.6	0.00E+00	0.00E+00	0.17E+03	0.0	0.0	5.1	0.00E+00	0.00E+00	0.20E+04	0.0	0.0	1.2	0.00E+00	0.00E+00	0.00E+00
6	0.0	0.0	3.6	0.00E+00	0.00E+00	0.17E+03	0.0	0.0	5.1	0.00E+00	0.00E+00	0.20E+04	0.0	0.0	1.2	0.00E+00	0.00E+00	0.00E+00
7	0.0	0.0	3.6	0.00E+00	0.00E+00	0.17E+03	0.0	0.0	5.1	0.00E+00	0.00E+00	0.20E+04	0.0	0.0	1.2	0.00E+00	0.00E+00	0.00E+00
8	0.0	0.0	3.6	0.00E+00	0.00E+00	0.17E+03	0.0	0.0	5.1	0.00E+00	0.00E+00	0.20E+04	0.0	0.0	1.2	0.00E+00	0.00E+00	0.00E+00
9	0.0	0.0	3.6	0.00E+00	0.00E+00	0.17E+03	0.0	0.0	5.1	0.00E+00	0.00E+00	0.20E+04	0.0	0.0	1.2	0.00E+00	0.00E+00	0.00E+00
10	0.0	0.0	3.6	0.00E+00	0.00E+00	0.17E+03	0.0	0.0	5.1	0.00E+00	0.00E+00	0.20E+04	0.0	0.0	1.2	0.00E+00	0.00E+00	0.00E+00
11	0.0	0.0	3.6	0.00E+00	0.00E+00	0.17E+03	0.0	0.0	5.1	0.00E+00	0.00E+00	0.20E+04	0.0	0.0	1.2	0.00E+00	0.00E+00	0.00E+00
12	0.0	0.0	3.6	0.00E+00	0.00E+00	0.17E+03	0.0	0.0	5.1	0.00E+00	0.00E+00	0.20E+04	0.0	0.0	1.2	0.00E+00	0.00E+00	0.00E+00
13	0.0	0.0	3.6	0.00E+00	0.00E+00	0.17E+03	0.0	0.0	5.1	0.00E+00	0.00E+00	0.20E+04	0.0	0.0	1.2	0.00E+00	0.00E+00	0.00E+00
14	0.0	0.0	3.6	0.00E+00	0.00E+00	0.17E+03	0.0	0.0	5.1	0.00E+00	0.00E+00	0.20E+04	0.0	0.0	1.2	0.00E+00	0.00E+00	0.00E+00
15	0.0	0.0	3.6	0.00E+00	0.00E+00	0.17E+03	0.0	0.0	5.1	0.00E+00	0.00E+00	0.20E+04	0.0	0.0	1.2	0.00E+00	0.00E+00	0.00E+00
16	0.0	0.0	3.6	0.00E+00	0.00E+00	0.17E+03	1.4	1.4	5.1	0.66E+03	0.00E+00	0.20E+04	0.0	0.0	1.2	0.00E+00	0.00E+00	0.00E+00
17	35.2	35.2	146.1	0.74E+05	0.00E+00	0.68E+04	2.7	4.1	5.6	0.24E+04	0.00E+00	0.22E+04	34.5	34.5	98.1	0.20E+06	0.00E+00	0.40E+05
18	29.5	64.7	497.5	0.54E+05	0.00E+00	0.23E+05	3.4	7.5	9.4	0.37E+04	0.00E+00	0.36E+04	29.1	63.8	259.0	0.15E+06	0.00E+00	0.11E+06
19	0.0	64.7	434.2	0.00E+00	0.00E+00	0.20E+05	4.1	11.6	23.0	0.52E+04	0.00E+00	0.88E+04	0.0	63.8	25.4	0.00E+00	0.00E+00	0.10E+05
20	0.0	64.7	65.0	0.00E+00	0.00E+00	0.30E+04	1.4	12.9	29.5	0.66E+03	0.00E+00	0.11E+05	0.0	63.8	16.2	0.00E+00	0.00E+00	0.67E+04
21	0.0	64.7	42.0	0.00E+00	0.00E+00	0.29E+04	0.0	12.9	25.5	0.00E+00	0.00E+00	0.10E+05	0.0	63.8	11.8	0.00E+00	0.00E+00	0.49E+04
22	0.0	64.7	30.8	0.00E+00	0.00E+00	0.14E+04	0.7	13.6	26.4	0.18E+03	0.00E+00	0.10E+05	0.0	63.8	9.3	0.00E+00	0.00E+00	0.38E+04
23	0.0	64.7	24.3	0.00E+00	0.00E+00	0.11E+04	2.0	15.7	34.9	0.14E+04	0.00E+00	0.13E+05	0.0	63.8	7.6	0.00E+00	0.00E+00	0.31E+04
24	0.0	64.7	20.1	0.00E+00	0.00E+00	0.93E+03	0.0	15.7	31.1	0.00E+00	0.00E+00	0.12E+05	0.0	63.8	6.5	0.00E+00	0.00E+00	0.27E+04

Time	Sub-Basin 16 R	RR	Q	QE	QF	QT	Sub-Basin 17 R	RR	Q	QE	QF	QT	Sub-Basin 18 R	RR	Q	QE	QF	QT
1	0.0	0.0	7.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.0	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	6.4	0.00E+00	0.00E+00	0.00E+00
2	0.0	0.0	7.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.0	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	6.4	0.00E+00	0.00E+00	0.00E+00
3	0.0	0.0	7.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.0	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	6.4	0.00E+00	0.00E+00	0.00E+00
4	0.0	0.0	7.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.0	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	6.4	0.00E+00	0.00E+00	0.00E+00
5	0.0	0.0	7.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.0	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	6.4	0.00E+00	0.00E+00	0.00E+00
6	0.0	0.0	7.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.0	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	6.4	0.00E+00	0.00E+00	0.00E+00
7	0.0	0.0	7.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.0	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	6.4	0.00E+00	0.00E+00	0.00E+00
8	0.0	0.0	7.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.0	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	6.4	0.00E+00	0.00E+00	0.00E+00
9	0.0	0.0	7.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.0	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	6.4	0.00E+00	0.00E+00	0.00E+00
10	0.0	0.0	7.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.0	0.00E+00	0.00E+00	0.00E+00	21.6	21.6	70.6	0.00E+00	0.00E+00	0.00E+00
11	0.0	0.0	7.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.0	0.00E+00	0.00E+00	0.00E+00	5.4	27.0	185.9	0.00E+00	0.00E+00	0.00E+00
12	0.0	0.0	7.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	2.0	0.00E+00	0.00E+00	0.00E+00	0.7	27.7	170.7	0.00E+00	0.00E+00	0.00E+00
13	12.4	12.4	21.0	0.45E+05	0.00E+00	0.00E+00	10.3	10.3	5.6	0.55E+04	0.00E+00	0.00E+00	8.9	36.6	167.6	0.00E+00	0.00E+00	0.00E+00
14	47.1	59.4	708.9	0.55E+06	0.00E+00	0.17E+06	39.3	49.6	291.3	0.68E+05	0.00E+00	0.95E+05	0.7	37.2	203.8	0.00E+00	0.00E+00	0.00E+00
15	11.2	70.5	%1360.3	0.37E+05	0.00E+00	0.33E+05	9.3	58.9	173.1	0.46E+04	0.57E+04	0.57E+05	0.0	37.2	112.1	0.00E+00	0.00E+00	0.00E+00
16	0.6	71.2	332.6	0.14E+03	0.00E+00	0.81E+05	0.5	59.4	64.0	0.18E+02	0.63E+03	0.00E+00	0.0	37.2	72.6	0.00E+00	0.00E+00	0.00E+00
17	3.1	74.3	159.8	0.33E+04	0.00E+00	0.41E+05	2.6	62.0	43.6	0.42E+03	0.97E+04	0.00E+00	0.2	37.5	54.2	0.00E+00	0.00E+00	0.00E+00
18	0.4	74.7	141.1	0.59E+02	0.00E+00	0.34E+05	0.3	62.3	30.8	0.83E+01	0.12E+04	0.00E+00	0.0	37.5	44.0	0.00E+00	0.00E+00	0.00E+00
19	0.0	74.7	92.6	0.00E+00	0.00E+00	0.23E+05	0.0	62.3	21.3	0.00E+00	0.97E+04	0.00E+00	0.9	38.4	38.7	0.00E+00	0.00E+00	0.00E+00
20	0.2	74.9	66.8	0.18E+02	0.00E+00	0.00E+00	0.2	62.5	16.4	0.23E+01	0.15E+04	0.00E+00	0.2	38.6	37.5	0.00E+00	0.00E+00	0.00E+00
21	0.0	74.9	53.0	0.00E+00	0.00E+00	0.00E+00	0.0	62.5	13.2	0.00E+00	0.97E+04	0.00E+00	0.0	38.6	32.7	0.00E+00	0.00E+00	0.00E+00
22	0.0	74.9	43.0	0.00E+00	0.00E+00	0.00E+00	0.0	62.5	11.0	0.00E+00	0.15E+04	0.00E+00	0.0	38.6	28.3	0.00E+00	0.00E+00	0.00E+00
23	0.0	74.9	35.2	0.00E+00	0.00E+00	0.00E+00	0.0	62.5	9.4	0.00E+00	0.97E+04	0.00E+00	0.0	38.6	25.0	0.00E+00	0.00E+00	0.00E+00
24	0.0	74.9	31.4	0.00E+00	0.00E+00	0.00E+00	0.0	62.5	6.3	0.00E+00	0.15E+04	0.00E+00	0.0	38.6	22.4	0.00E+00	0.00E+00	0.00E+00

Time	R	RR	Q	QE	QF	QT	R	RR	Q	QE	QF	QT	R	RR	Q	QE	QF	QT
	Sub-Basin 19						Sub-Basin 20						Sub-Basin 21					
1	0.0	0.0	4.5	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	4.0	0.00E+00	0.00E+00	0.00E+00
2	0.0	0.0	4.6	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	4.0	0.00E+00	0.00E+00	0.00E+00
3	0.0	0.0	4.6	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	4.0	0.00E+00	0.00E+00	0.00E+00
4	0.0	0.0	4.6	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	4.0	0.00E+00	0.00E+00	0.00E+00
5	0.0	0.0	4.5	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	4.0	0.00E+00	0.00E+00	0.00E+00
6	0.0	0.0	4.5	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	4.0	0.00E+00	0.00E+00	0.00E+00
7	0.0	0.0	4.6	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	4.0	0.00E+00	0.00E+00	0.00E+00
8	0.0	0.0	4.6	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	4.0	0.00E+00	0.00E+00	0.00E+00
9	0.0	0.0	4.6	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	4.0	0.00E+00	0.00E+00	0.00E+00
10	23.2	23.2	76.8	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	4.0	0.00E+00	0.00E+00	0.00E+00
11	5.9	29.0	122.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	4.0	0.00E+00	0.00E+00	0.00E+00
12	0.7	29.8	77.1	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	3.2	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	4.0	0.00E+00	0.00E+00	0.00E+00
13	9.5	39.3	186.4	0.00E+00	0.00E+00	0.00E+00	12.0	12.0	9.4	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	4.0	0.00E+00	0.00E+00	0.00E+00
14	0.7	40.0	95.2	0.00E+00	0.00E+00	0.00E+00	45.9	57.9	499.6	0.00E+00	0.75E+04	0.00E+00	0.0	0.0	4.0	0.00E+00	0.00E+00	0.00E+00
15	0.0	40.0	59.3	0.00E+00	0.00E+00	0.00E+00	10.9	68.8	383.7	0.00E+00	0.35E+05	0.00E+00	0.0	0.0	4.0	0.00E+00	0.00E+00	0.00E+00
16	0.0	40.0	42.9	0.00E+00	0.00E+00	0.00E+00	0.6	69.4	111.4	0.00E+00	0.10E+05	0.00E+00	1.0	1.0	4.0	0.00E+00	0.00E+00	0.00E+00
17	0.2	40.3	35.2	0.00E+00	0.00E+00	0.00E+00	3.0	72.4	71.0	0.00E+00	0.50E+05	0.00E+00	2.0	3.0	4.1	0.00E+00	0.00E+00	0.00E+00
18	0.0	40.3	28.7	0.00E+00	0.00E+00	0.00E+00	0.4	72.7	53.3	0.00E+00	0.12E+05	0.00E+00	2.5	5.5	4.9	0.00E+00	0.00E+00	0.00E+00
19	1.0	41.2	29.5	0.00E+00	0.00E+00	0.00E+00	0.0	72.7	36.1	0.00E+00	0.50E+05	0.00E+00	3.0	8.5	8.0	0.00E+00	0.00E+00	0.00E+00
20	0.2	41.5	26.2	0.00E+00	0.00E+00	0.00E+00	0.2	72.9	27.3	0.00E+00	0.13E+05	0.00E+00	1.0	9.5	9.7	0.00E+00	0.00E+00	0.00E+00
21	0.0	41.5	22.5	0.00E+00	0.00E+00	0.00E+00	0.0	72.9	21.9	0.00E+00	0.50E+05	0.00E+00	0.0	9.5	9.4	0.00E+00	0.00E+00	0.00E+00
22	0.0	41.5	19.9	0.00E+00	0.00E+00	0.00E+00	0.0	72.9	18.0	0.00E+00	0.13E+05	0.00E+00	0.5	10.0	9.9	0.00E+00	0.00E+00	0.00E+00
23	0.0	41.5	17.9	0.00E+00	0.00E+00	0.00E+00	0.0	72.9	15.4	0.00E+00	0.50E+05	0.00E+00	1.5	11.5	13.1	0.00E+00	0.00E+00	0.00E+00
24	0.0	41.5	16.3	0.00E+00	0.00E+00	0.00E+00	0.0	72.9	13.5	0.00E+00	0.13E+05	0.00E+00	0.0	11.5	12.2	0.00E+00	0.00E+00	0.00E+00

***** 100-YEAR FLOOD *****

************** TOTAL SEDIMENT PRODUCTION VOLUME ************

	??? EROSION ???	??? FAILURE ???	??? TORRENT ???	??? TOTAL ???	??? DISCHARGE ???
1	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.2087E+07
2	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.2012E+07
3	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.6590E+06
4	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.3211E+07
5	0.0000E+00	0.2373E+02	0.0000E+00	0.2373E+02	0.4585E+07
6	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.2082E+07
7	0.5562E+04	0.0000E+00	0.4091E+04	0.9654E+04	0.1652E+07
8	0.5365E+04	0.0000E+00	0.4761E+04	0.1013E+05	0.1157E+07
9	0.6897E+05	0.0000E+00	0.5238E+05	0.1214E+06	0.5705E+07
10	0.1129E+04	0.0000E+00	0.0000E+00	0.1129E+04	0.4023E+06
11	0.1525E+02	0.0000E+00	0.0000E+00	0.1525E+02	0.1977E+05

12	0.2421E+06	0.0000E+00	0.1300E+06	0.3722	0.1676E+07
13	0.1276E+06	0.0000E+00	0.6113E+05	0.1888E+06	0.4743E+07
14	0.1430E+05	0.0000E+00	0.1031E+06	0.1174E+06	0.9650E+06
15	0.3517E+06	0.0000E+00	0.1788E+06	0.5305E+06	0.1631E+07
16	0.6345E+06	0.0000E+00	0.6856E+06	0.1320E+07	0.1131E+08
17	0.7912E+05	0.5079E+05	0.1517E+06	0.2817E+06	0.2563E+07
18	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.4765E+07
19	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.3231E+07
20	0.0000E+00	0.3038E+06	0.0000E+00	0.3038E+06	0.4677E+07
21	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.4871E+06
TOTAL	0.1530E+07	0.3546E+06	0.1372E+07	0.3257E+07	0.5980E+08

TOTAL SEDIMENT PRODUCTION = 0.33E+07

****************** PRINTOUT OF WASH LOAD COMPUTATION ********************

NUDED AREA	0-ORDER VALLEY	1-ORDER VALLEY
0.664E-03	0.775E-03	0.190E-03
0.327E-02	0.121E-01	0.613E-02
0.751E-03	0.844E-03	0.196E-03
0.336E-02	0.124E-01	0.624E-02
0.688E-02	0.424E-01	0.303E-01
0.350E-02	0.132E-01	0.671E-02
0.396E-02	0.167E-01	0.928E-02
0.309E-03	0.155E-03	0.219E-04
0.382E-02	0.152E-01	0.805E-02
0.222E-03	0.729E-04	0.751E-05
0.209E-03	0.580E-04	0.500E-05
0.124E-01	0.213E+00	0.311E+00
0.154E-01	0.233E+00	0.300E+00
0.381E-03	0.252E-03	0.431E-04
0.182E-01	0.403E+00	0.685E+00
0.193E-01	0.346E+00	0.524E+00
0.143E-01	0.205E+00	0.266E+00
0.472E-02	0.168E-01	0.830E-02
0.437E-02	0.161E-01	0.848E-02
0.175E-01	0.282E+00	0.386E+00
0.211E-03	0.614E-04	0.553E-05

2.2 Cálculo de producción de sedimento anual

---- QSDAY.FOR ----

2.

```
CCCCCC    ***  PROGRAM  FOR  COMPUTAION  OF  SEDIMENT  PRODUCTION   ***
CCCCCC    ***  FINAL  MODIFICATION  ON  4  OCTOBER  1991             ***
      INTEGER*2 STA, NN, DM, DD, YR(24)
      INTEGER*2 ASTA(24), MON(12), YEAR(21)
      INTEGER RR(21,12,31), KKNT(21,12,31), RMAX(21,12,31)
      CHARACTER NASTA(24)*9, OASTA(24)*9
      REAL SR(21,12,31), MR(21,12), QSD(21,12,31), QSM(21,12), QMM(21)
C
      DATA  NASTA
     *      / 'R3005.DAT', 'R3024.DAT', 'R3027.DAT', 'R3029.DAT',
     *        'R3035.DAT', 'R3038.DAT', 'R3040.DAT', 'R3042.DAT',
     *        'R3047.DAT', 'R3052.DAT', 'R3070.DAT', 'R3080.DAT',
     *        'R3108.DAT', 'R3111.DAT', 'R3112.DAT', 'R3132.DAT',
     *        'R3141.DAT', 'R3169.DAT', 'R3170.DAT', 'R8049.DAT',
     *        'R8053.DAT', 'R8054.DAT', 'R8056.DAT', 'R8072.DAT' /
      DATA  OASTA
     *      / 'R3005.OUT', 'R3024.OUT', 'R3027.OUT', 'R3029.OUT',
     *        'R3035.OUT', 'R3038.OUT', 'R3040.OUT', 'R3042.OUT',
     *        'R3047.OUT', 'R3052.OUT', 'R3070.OUT', 'R3080.OUT',
     *        'R3108.OUT', 'R3111.OUT', 'R3112.OUT', 'R3132.OUT',
     *        'R3141.OUT', 'R3169.OUT', 'R3170.OUT', 'R8049.OUT',
     *        'R8053.OUT', 'R8054.OUT', 'R8056.OUT', 'R8072.OUT' /
      DATA  YR
     *      / 21, 21, 21, 17, 21, 18, 21, 21, 12, 18, 17, 21,
     *        20, 21, 20, 18, 19, 17, 17, 10, 17, 17, 17, 15 /
      DATA  MON
     *      / 31, 28, 31, 30, 31, 30, 31, 31, 30, 31, 30, 31  /
      OPEN(6,FILE='PRN')
C       ***  INITIALIZATION OF BASIN RAINFALL  ***
      DO 10 J=1,21
      DO 10 K=1,12
      MR(J,K)=0.0
      QSM(J,K)=0.0
      DO 10 L=1,31
      SR(J,K,L)=0.0
      KKNT(J,K,L)=0
      RMAX(J,K,L)=0
      QSD(J,K,L)=0.0
   10 CONTINUE
      DO 99 I=1,24
CCCCCC    ***  DATA  INITIALIZATION  ***
      DO 1 J=1,21
      DO 1 K=1,12
      DO 1 L=1,31
      RR(J,K,L)=9999
    1 CONTINUE
CCCCCC    ***  DATA   INPUT  ***
      OPEN(1,FILE=NASTA(I),ACCESS='SEQUENTIAL',STATUS='OLD')
      OPEN(2,FILE=OASTA(I),ACCESS='SEQUENTIAL',STATUS='UNKNOWN')
      READ(1,100) ASTA(I)
      DO 2 J=1,YR(I)
      READ(1,110) YEAR(J)
      IF (MOD(YEAR(J),4).EQ.0) THEN
      MON(2)=29
      ELSE
      MON(2)=28
      END IF
      DO 2 K=1,12
      MMM=MON(K)
      DO 21 JJ=1,3
      IF (JJ-2) 500,501,502
  500 READ(1,120)  (RR(YEAR(J)-1966,K,L),L=1,10)
      GO TO 21
  501 READ(1,120)  (RR(YEAR(J)-1966,K,L),L=11,20)
      GO TO 21
  502 READ(1,121)  (RR(YEAR(J)-1966,K,L),L=21,MMM)
   21 CONTINUE
    2 CONTINUE
CCCCCC    ***  OUTPUT OF MODIFIED DAILY RAINFALL  ***
C     DO 5 J=1,21
C     WRITE(6,8000) NASTA(I), J+1966
C     WRITE(6,1001) (MNT,MNT=1,12)
C     WRITE(6,1002)
C     DO 5 L=1,31
C     WRITE(6,1199) L, (KKNT(J,K,L), RR(J,K,L), K=1,12)
```

使用 $Q_s = 14.6 \times R^2$

($R < 8$ mm/day $Q_s = 0$)

```
C   5 CONTINUE
CCCCC   ***  CALCULATION OF BASIN RAINFALL  ***
C         ===     BY ARTHMETIC MEAN      ====
      DO 3 J=1,21
      IF (MOD(J+1966,4).EQ.0) THEN
      MON(2)=29
      ELSE
      MON(2)=28
      END IF
      DO 3 K=1,12
      MT=MON(K)
      DO 3 L=1,MT
      IF (RR(J,K,L).GT.5000 .OR. RR(J,K,L).LT.-5000) GO TO 3
      KKNT(J,K,L)=KKNT(J,K,L)+1
      IF (RR(J,K,L).GT.RMAX(J,K,L)) RMAX(J,K,L)=RR(J,K,L)
      SR(J,K,L)=SR(J,K,L)+RR(J,K,L)/10
    3 CONTINUE
   99 CONTINUE
C
      DO 54 J=1,21
      IF (MOD(J+1966,4).EQ.0) THEN
      QMM(J)=0.0
      MON(2)=29
      ELSE
      MON(2)=28
      END IF
      DO 54 K=1,12
      MN=MON(K)
      DO 60 L=1,MN
      IF (KKNT(J,K,L).EQ.0) KKNT(J,K,L)=99999
      SR(J,K,L)=0.6*SR(J,K,L)/KKNT(J,K,L)
      IF (SR(J,K,L).LE.8.0) GO TO 60
      QSD(J,K,L)=14.6*(SR(J,K,L)**2)
      MR(J,K)=MR(J,K)+SR(J,K,L)
      QSM(J,K)=QSM(J,K)+QSD(J,K,L)
   60 CONTINUE
      QMM(J)=QMM(J)+QSM(J,K)
   54 CONTINUE
CCCCCC    ***             OUT - RAVE              ***
C     DO 55 J=1,21
C     WRITE(6,1000) J+1966
C     WRITE(6,1001) (MNT,MNT=1,12)
C     WRITE(6,1002)
C     DO 56 L=1,31
C     WRITE(6,1100) L, (KKNT(J,K,L), SR(J,K,L), K=1,12)
C  56 CONTINUE
C     WRITE(6,1002)
C     WRITE(6,1111) (MR(J,K),K=1,12)
C  55 CONTINUE
C     WRITE(6,1002)
CCCCCC    ***             OUT - RMAX              ***
C     DO 57 J=1,21
C     WRITE(6,1000) J+1966
C     WRITE(6,1001) (MNT,MNT=1,12)
C     WRITE(6,1002)
C     DO 58 L=1,31
C     WRITE(6,1109) L, (RMAX(J,K,L), K=1,12)
C  58 CONTINUE
C     WRITE(6,1002)
C     WRITE(6,1111) (MR(J,K),K=1,12)
C  57 CONTINUE
C     WRITE(6,1002)
CCCCCC    ***             OUT - DAILY QS            ***
      DO 55 J=1,21
      WRITE(6,1000) J+1966
      WRITE(6,1001) (MNT,MNT=1,12)
      WRITE(6,1002)
      DO 56 L=1,31
      WRITE(6,1100) L, (QSD(J,K,L), K=1,12)
   56 CONTINUE
      WRITE(6,1002)
      WRITE(6,1111) (QSM(J,K),K=1,12)
      WRITE(6,1200)  QMM(J)
   55 CONTINUE
      WRITE(6,1002)
```

```
CCCCCC    ***   FORMAT FOR IN AND OUT     ****
  100 FORMAT(2I4)
C 109 FORMAT(4X,I4)
  110 FORMAT(4X,I4)
  120 FORMAT(11X,10I5)
  121 FORMAT(11X,11I5)
 1000 FORMAT(1H1,///10X,6H****  ,I4,6H  ****)
 8000 FORMAT(1H1,///10X,6H****  ,A,2X,2H (,I4,2H) ,2X,6H  ****)
 1001 FORMAT(//10X,12(5X,I2,4X),/)
 1002 FORMAT('-----------------------------------------------------',
     *       '-----------------------------------------------------',
     *       '------------------------------------------')
 1100 FORMAT(5X,I2,1X,12(2X,F8.0,1X))
 1109 FORMAT(5X,I2,1X,12(2X,I7,1X))
 1111 FORMAT(8X,12(2X,F8.0,1X))
 1200 FORMAT(/8X,11HQS-SUM ==> ,F10.0, 5HM3/YR)
 1199 FORMAT(5X,I2,1X,12(1X,I2,1X,I5,1X))
 2200 FORMAT(10I5)
 9999 STOP
      END
```

Total

表3.2-1

毎回生産土砂量 全量

$Q_s = 14.6 R_{day}^2$

**** 1967 ****

	1	2	3	4	5	6	7	8	9	10	11	12
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	3691.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	3578.	0.	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	0.	0.	1672.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	2122.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	2102.	0.	1407.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
22	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
23	0.	0.	0.	1346.	0.	0.	0.	0.	0.	0.	0.	0.
24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
25	0.	0.	0.	0.	0.	0.	1388.	0.	0.	0.	0.	0.
26	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
27	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	2168.
28	0.	0.	0.	0.	0.	0.	0.	0.	0.	1084.	0.	0.
29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
30	1332.	0.	0.	1999.	0.	0.	0.	0.	1394.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	1332.	0.	1672.	11146.	3691.	1407.	1388.	0.	1394.	1084.	0.	2168.

QS-SUM ---> 25281.M3/YR

**** 1958 ****

	1	2	3	4	5	6	7	8	9	10	11	12
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	1257.	0.	4618.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	7931.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	982.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	2813.	0.	0.	0.	0.	1159.	2594.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	4685.	0.	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	1298.	0.	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	958.	0.	0.	0.	0.	0.	0.	0.
16	0.	0.	0.	0.	2421.	1312.	0.	0.	0.	0.	1398.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	1105.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
22	0.	1090.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
23	0.	0.	0.	0.	0.	0.	985.	0.	0.	0.	0.	0.
24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
25	0.	0.	0.	1158.	0.	0.	0.	0.	0.	0.	0.	0.
26	0.	0.	0.	2250.	0.	0.	0.	0.	0.	0.	0.	0.
27	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
28	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
30	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	1090.	0.	13462.	4361.	13862.	985.	0.	1159.	3699.	1398.	0.

QS-SUM --> 40026.M3/YR

QSDAY

Coarse Portion

**** 1967 ****

Bamjiang

表3.2-1 Coarse Material

表3.2-4a inflow

	1	2	3	4	5	6	7	8	9	10	11	12
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	0.	772.	0.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	751.	0.	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
16	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
18	0.	0.	378.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	469.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	465.	0.	324.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
22	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
23	0.	0.	0.	311.	0.	0.	0.	0.	0.	0.	0.	0.
24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
25	0.	0.	0.	0.	0.	0.	320.	0.	0.	0.	0.	0.
26	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
27	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	478.
28	0.	0.	0.	0.	0.	0.	0.	0.	0.	256.	0.	0.
29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
30	308.	0.	0.	444.	0.	0.	0.	0.	321.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	308.	0.	378.	2439.	772.	324.	320.	0.	321.	256.	0.	478.

QS-SUM ---> 5595.M3/YR

**** 1968 ****

	1	2	3	4	5	6	7	8	9	10	11	12
1	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
2	0.	0.	0.	292.	0.	946.	0.	0.	0.	0.	0.	0.
3	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
6	0.	0.	0.	0.	0.	1541.	0.	0.	0.	0.	0.	0.
7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
8	0.	0.	0.	0.	234.	0.	0.	0.	0.	0.	0.	0.
9	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
10	0.	0.	0.	604.	0.	0.	0.	0.	274.	562.	0.	0.
11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
12	0.	0.	0.	958.	0.	0.	0.	0.	0.	0.	0.	0.
13	0.	0.	0.	301.	0.	0.	0.	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
15	0.	0.	0.	0.	229.	0.	0.	0.	0.	0.	0.	0.
16	0.	0.	0.	0.	528.	304.	0.	0.	0.	0.	322.	0.
17	0.	0.	0.	0.	0.	0.	0.	0.	0.	260.	0.	0.
18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
22	0.	257.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
23	0.	0.	0.	0.	0.	0.	235.	0.	0.	0.	0.	0.
24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
25	0.	0.	0.	271.	0.	0.	0.	0.	0.	0.	0.	0.
26	0.	0.	0.	494.	0.	0.	0.	0.	0.	0.	0.	0.
27	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
28	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
30	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
31	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	0.	257.	0.	2921.	990.	2790.	235.	0.	274.	822.	322.	0.

QS-SUM ==> 8610.M3/YR

29

2.3 Cálculo de estimación de "Bed Load" por fórmula de ASHIDA

---- ASHIDA.BAS ----

```
50 REM ------------------------------------------------------
53 REM      Estimation of Bed Load by ASHIDA Formula
54 REM
55 REM   save "ashida.bas",a
56 REM
58 REM           Feb. 17 , 1989    M.Ohuchi
60 REM ------------------------------------------------------
100 DIM DM(8),QQ(10),AG(8),UC(8),UU(8),HH(8),FF(8)
110 DIM EE(8),Q1(8),A$(8),QD(10),QH(10)
112 REM
114 REM ------------------------------------------------------
120 FOR I=1 TO 8
130 READ A$(I)
140 NEXT I
150 REM ----cs = no. of case -----
160 READ CS
170 REM ----qq =  discharge ------
180 FOR I=1 TO 10
190 READ QQ(I)
200 NEXT I
205 FOR L2=1 TO CS
210 REM -----s$ = location name
230 READ S$
240 REM -----dm = grain size distribution --
250 FOR I=1 TO 8
260 READ DM(I)
270 NEXT I
280 REM -----rc = roughness coefficient
290 READ RC
300 REM ----rb = river bed slope
310 READ RB
320 ST=ATN(RB)
325 CO=COS(ST)
330 REM
340 REM  ----ag = average graun size    (mm)
350 AG(1)=250
360 AG(2)=150
370 AG(3)=75
380 AG(4)=40
390 AG(5)=20
400 AG(6)=7.5
410 AG(7)=3
420 AG(8)=1
430 REM
440 REM ----- print out ---- no.1-----------------------------------
450 FOR LL=1 TO 5
460 LPRINT " "
470 NEXT LL
480 LPRINT "    *******  calculation  result  of  bed  load *******"
490 LPRINT :  LPRINT
500 LPRINT "    (1)     input      station name : ";
510 LPRINT S$
520 LPRINT "                                   n : ";
530 LPRINT USING "#.##";RC
540 LPRINT "                                   i : ";
550 LPRINT USING "#.####";RB
560 REM ---------------------------------------------------------
570 FOR QK=1 TO 10
580 Q=QQ(QK)
590 B=5*Q^.5
600 FI=.623
610 FOR GK=1 TO 8
620 GS=AG(GK)
630 IF GS > 3.03 GOTO 670
```

160: 17

190: 5, 10, 20, 30, 50, 80, 100, 150, 200, 400 m³/s

280: (n)

300: (i)

320: (radian, i)

プログラム ASHIDA.BAS

4枚

3

Data 出展

17ケース

BP-1〜BP-17

α 掃流砂曲線関係定数

$Q_s = A * Q^B$

Q_s: (m³/day)

Q: m³/s

↓

表3.2-2 --- T-2

590: → $B = 2\sqrt{Q}$ 最終レポートでは変更している。(レジューム理論による河道幅)

```
640 IF GS > 1.18 GOTO 690
650 TC=55*GS*.1
660 GOTO 710
670 TC=80.9*GS*.1
680 GOTO 710
690 GG=GS*.1
700 TC=134.6*GG^1.409
710 REM   ---------------
720 REM   -----tractive force -----
730 H1=Q*RC
740 H2=B*RB^.5
750 H3=(H1/H2)^.6
760 TF=980*H3*100*RB
762 E1=2.65/1.65*RB
768 E2=2*(.425-E1)
770 E3=1-E1
775 A1=(E2/E3)^.5
780 A2=A1*A1
785 TU=TF/(1.65*980*GS*.1)
800 REM  ----- sediment  calculation ----
805 T1=RB^.5
810 T2=(12-24*T1)/CO
815 T3=1.5-T1
820 S1=T2*(TU^T3)
825 T1=TC/TF
830 S2=1-A2*T1
835 S3=1-A1*(T1^.5)
840 T2=(GS*.1)^3
845 S4=(1.65*980*T2)^.5
848 UB=S1*S2*S3*S4
850 REM -----------------------------------
860 UC(GK)=TC^.5
870 UU(GK)=TF^.5
880 HH(GK)=H3
890 FF(GK)=A1
900 EE(GK)=TU
910 Q1(GK)=UB*DN(GK)*.01
920 NEXT GK
930 REM ---------------------------------
940 Q2=0
950 Q3=0
960 Q4=0
970 Q5=0
975 Q6=0
977 Q7=0
980 FOR GK=1 TO 8
990 Q2=Q1(GK)+Q2
1000 NEXT GK
1010 REM ---------------------------------
1020 Q3=Q2*B*100
1030 Q4=Q3*2.65*.001
1040 Q5=Q4*86400!*.001
1045 Q6=Q3*.0864
1046 QD(QK)=Q6
1048 Q7=Q3*.0036
1049 QH(QK)=Q7
1050 REM  ------ print out ----  no.2 ------
1060 FOR I=1 TO 5
1070 LPRINT
1080 NEXT I
1090 LPRINT  "     (2)  bed load   "
1100 LPRINT  "                                    case : ";QK
1110 LPRINT  "                                    q    : ";Q;
1112 LPRINT  " (cms)  "
```

```
1120 LPRINT "                                   b    : ";
1122 LPRINT USING "####.##";B
1130 LPRINT : LPRINT :LPRINT
1140 LPRINT "       ---------------------------------------------------------------"
1150 LPRINT "         rango  dist.  u*c     u*     h    alfa     tau       qb"
1160 LPRINT "          (mm)    (%)  (cm/s)  (cm/s) (m)                  (cm3/s/cm)
 "
1170 LPRINT "       ---------------------------------------------------------------"
1172 FOR LL=1 TO 8
1174 LPRINT "      ";A$(LL);"  ";
1176 LPRINT USING "##";DM(LL);
1178 LPRINT USING "########";UC(LL);
1180 LPRINT USING "########";UU(LL);
1182 LPRINT USING "####.##";HH(LL);
1184 LPRINT USING "####.##";FF(LL);
1186 LPRINT USING "####.##";EE(LL);
1192 LPRINT USING "######.####";Q1(LL)
1200 NEXT LL
1210 LPRINT "       ---------------------------------------------------------------"
1220 LPRINT: LPRINT
1230 LPRINT "    qb = ";
1232 LPRINT USING "########.####";Q3;
1240 LPRINT " (cm3/sec)  "
1250 LPRINT "         = ";
1252 LPRINT USING "########.####";Q4;
1260 LPRINT "  (kg/sec)  "
1270 LPRINT "         = ";
1272 LPRINT USING "########.####";Q5;
1280 LPRINT "  (ton/day)  "
1281 LPRINT "         = ";
1282 LPRINT USING "########.####";Q6;
1284 LPRINT "  (m3/day)  "
1285 LPRINT "         = ";
1286 LPRINT USING "########.####";Q7;
1288 LPRINT "  (m3/hour)  "
1292 LPRINT:LPRINT:LPRINT
1294 LPRINT "          ***   ***   ***   ***   ***   ***   ***   ***   ***   **
*  *** "
1298 NEXT QK
1300 REM  ---------------------------
1305 Y1=LOG(QD(2))/LOG(10)
1310 Y2=LOG(QD(7))/LOG(10)
1313 B1=Y2-Y1
1316 A1=Y1-B1
1320 A1=10^A1
1325 Y1=LOG(QH(2))/LOG(10)
1330 Y2=LOG(QH(7))/LOG(10)
1343 B2=Y2-Y1
1346 A2=Y1-B2
1350 A2=10^A2
1352 LPRINT "    -------- Daily ----  Qs(m3/day)=Alfa*Q(m3/sec)**Beta  -------
"
1354 LPRINT:LPRINT
1356 LPRINT "                          Alfa = ";USING "#####.####";A1
1358 LPRINT "                          Beta = ";USING "#####.####";B1
1360 LPRINT:LPRINT
1361 LPRINT "    -------- Hourly ---  Qs(m3/hour)=Alfa*Q(m3/sec)**Beta  ------
-"
1362 LPRINT:LPRINT
1366 LPRINT "                          Alfa = ";USING "#####.####";A2
1368 LPRINT "                          Beta = ";USING "#####.####";B2
1390 NEXT L2
1394 LPRINT "          ***   ***   ***   ***   ***   ***   ***   ***   ***   **
*  *** "
```

```
1395 END
1400 DATA "   >d>200","200>d>100","100>d> 50"," 50>d> 30"
1410 DATA " 30>d> 10"," 10>d>  5","  5>d>  1","  1>d    "
1420 DATA 17
1425 DATA 5,10,20,30
1427 DATA 50,80,100,150,200,400
1430 DATA "BP-1  Mucuruba    (B-1) "
1440 DATA 30,26,9,7,11,6,7,4
1450 DATA 0.04,0.0667
1460 DATA "BP-2   Virgen     (B-3) "
1470 DATA 50,5,8,7,10,4,9,7
1480 DATA 0.04,0.1
1490 DATA "BP-3   Tabay    (B-2) "
1500 DATA 13,20,10,7,18,7,11,14
1510 DATA 0.04,0.05
1520 DATA "BP-4   La Mucuy    (B-3) "
1530 DATA 50,5,8,7,10,4,9,7
1540 DATA 0.04,0.1
1550 DATA "BP-5   Merida      (B-4) "
1560 DATA 0,16,18,13,17,6,16,14
1570 DATA 0.04,0.04
1580 DATA "BP-6   Mucujun     (B-5) "
1590 DATA 26,14,13,11,14,8,11,3
1600 DATA 0.04,0.04
1610 DATA "BP-7  San Jacinto (B-3) "
1620 DATA 50,5,8,7,10,4,9,7
1630 DATA 0.04,0.1
1640 DATA "BP-8   Albarregas    (B-5) "
1650 DATA 26,14,13,11,14,8,11,3
1660 DATA 0.04,0.0333
1670 DATA "BP-9   Ejido         (B-6) "
1680 DATA 10,18,21,2,10,3,13,23
1690 DATA 0.04,0.02
1700 DATA "BP-10  El Morro      (B-7) "
1710 DATA 0,6,20,10,20,13,19,12
1720 DATA 0.04,0.0333
1730 DATA "BP-11  Tostos        (B-7) "
1740 DATA 0,6,20,10,20,13,19,12
1750 DATA 0.04,0.1
1760 DATA "BP-12  N. Senora     (B-8) "
1770 DATA 0,15,30,10,20,5,14,6
1780 DATA 0.04,0.05
1790 DATA "BP-13                (B-5) "
1800 DATA 26,14,13,11,14,8,11,3
1810 DATA 0.04,0.05
1820 DATA "BP-14                (B-9) "
1830 DATA 0,21,6,5,16,12,28,12
1840 DATA 0.04,0.02
1850 DATA "BP-15  Las Gonzales  (B-10) "
1860 DATA 40,16,10,5,6,6,12,5
1870 DATA 0.04,0.04
1880 DATA "BP-16  La Sucia      (B-10) "
1890 DATA 40,16,10,5,6,6,12,5
1900 DATA 0.04,0.04
1910 DATA "BP-17  La Guillas    (B-11) "
1920 DATA 0,0,13,17,22,10,24,14
1930 DATA 0.04,0.0125
```

Data.

Grain Size distribution

Roughness Coefficient ; River bed slope

ASHIDA.BAS
計算結果.
全51枚

****** calculation result of bed load ******

(1) input station name : BP-1 Mucuruba (B-1)
n : 0.04
i : 0.0667

(2) bed load

case : 1
q : 5 (cms) → 流量 (m³/s.)
b : 11.18 → ?

range (mm)	dist. (%)	u*c (cm/s)	u* (cm/s)	h (m)	alfa	tau	qb (cm3/s/cm)
>d>200	30	45	36	0.20	0.84	0.03	0.5310
200>d>100	26	35	36	0.20	0.84	0.05	6.2026
100>d> 50	9	25	36	0.20	0.84	0.11	7.6823
50>d> 30	7	18	36	0.20	0.84	0.20	8.7121
30>d> 10	11	13	36	0.20	0.84	0.41	15.3256
10>d> 5	6	8	36	0.20	0.84	1.09	7.9970
5>d> 1	7	5	36	0.20	0.84	2.72	8.1137
1>d	4	2	36	0.20	0.84	8.15	3.7709

qb = 65444.3000 (cm3/sec)
= 173.4274 (kg/sec)
= 14984.1300 (ton/day)
= 5654.3870 (m3/day)
= 235.5995 (m3/hour)

$B = 5\sqrt{Q}$.

*** *** *** *** *** *** *** *** *** *** ***

(2) bed load

case : 2
q : 10 (cms)
b : 15.81

range (mm)	dist. (%)	u*c (cm/s)	u* (cm/s)	h (m)	alfa	tau	qb (cm3/s/cm)
>d>200	30	45	40	0.25	0.84	0.04	1.0439
200>d>100	26	35	40	0.25	0.84	0.07	15.4923
100>d> 50	9	25	40	0.25	0.84	0.13	12.6139
50>d> 30	7	18	40	0.25	0.84	0.25	12.5603
30>d> 10	11	13	40	0.25	0.84	0.50	21.0353
10>d> 5	6	8	40	0.25	0.84	1.34	10.6464
5>d> 1	7	5	40	0.25	0.84	3.34	10.6666
1>d	4	2	40	0.25	0.84	10.03	4.9124

qb = 140675.8000 (cm3/sec)
= 372.7908 (kg/sec)
= 32209.1200 (ton/day)
= 12154.3900 (m3/day)
= 506.4327 (m3/hour)

*** *** *** *** *** *** *** *** *** *** ***

(2) bed load

case : 3
q : 20 (cms)
b : 22.36

range (mm)	dist. (%)	u*c (cm/s)	u* (cm/s)	h (m)	alfa	tau	qb (cm3/s/cm)
>d>200	30	45	45	0.31	0.84	0.05	8.7911
200>d>100	26	35	45	0.31	0.84	0.08	30.8502
100>d> 50	9	25	45	0.31	0.84	0.16	19.2810
50>d> 30	7	18	45	0.31	0.84	0.31	17.7680
30>d> 10	11	13	45	0.31	0.84	0.62	28.6148
10>d> 5	6	8	45	0.31	0.84	1.65	14.1207
5>d> 1	7	5	45	0.31	0.84	4.12	13.9962
1>d	4	2	45	0.31	0.84	12.35	6.3951

qb = 312640.7000 (cm3/sec)
= 828.4980 (kg/sec)
= 71582.2300 (ton/day)
= 27012.1600 (m3/day)
= 1125.5070 (m3/hour)

*** *** *** *** *** *** *** *** *** *** ***

(2) bed load

case : 4
q : 30 (cms)
b : 27.39

range (mm)	dist. (%)	u*c (cm/s)	u* (cm/s)	h (m)	alfa	tau	qb (cm3/s/cm)
>d>200	30	45	47	0.34	0.84	0.06	17.6625
200>d>100	26	35	47	0.34	0.84	0.09	43.4422
100>d> 50	9	25	47	0.34	0.84	0.19	24.3212
50>d> 30	7	18	47	0.34	0.84	0.35	21.6106
30>d> 10	11	13	47	0.34	0.84	0.70	34.1391
10>d> 5	6	8	47	0.34	0.84	1.86	16.6322
5>d> 1	7	5	47	0.34	0.84	4.65	16.3944
1>d	4	2	47	0.34	0.84	13.94	7.4598

qb = 497501.6000 (cm3/sec)
= 1318.3790 (kg/sec)
= 113908.0000 (ton/day)
= 42984.1400 (m3/day)
= 1791.0060 (m3/hour)

*** *** *** *** *** *** *** *** *** *** ***

(2) bed load

case : 5
q : 50 (cms)
b : 35.36

range (mm)	dist. (%)	u*c (cm/s)	u* (cm/s)	h (m)	alfa	tau	qb (cm3/s/cm)
>d>200	30	45	51	0.40	0.84	0.07	34.5763
200>d>100	26	35	51	0.40	0.84	0.11	64.0407
100>d> 50	9	25	51	0.40	0.84	0.22	32.1560
50>d> 30	7	18	51	0.40	0.84	0.41	27.4836
30>d> 10	11	13	51	0.40	0.84	0.81	42.5071
10>d> 5	6	8	51	0.40	0.84	2.17	20.4133
5>d> 1	7	5	51	0.40	0.84	5.42	19.9946
1>d	4	2	51	0.40	0.84	16.25	9.0546

qb = 884683.0000 (cm3/sec)
= 2344.4100 (kg/sec)
= 202557.1000 (ton/day)
= 76436.6100 (m3/day)
= 3184.8590 (m3/hour)

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(2) bed load

case : 6
q : 80 (cms)
b : 44.72

range (mm)	dist. (%)	u*c (cm/s)	u* (cm/s)	h (m)	alfa	tau	qb (cm3/s/cm)
>d>200	30	45	55	0.46	0.84	0.07	57.0222
200>d>100	26	35	55	0.46	0.84	0.12	88.6387
100>d> 50	9	25	55	0.46	0.84	0.25	41.1243
50>d> 30	7	18	55	0.46	0.84	0.47	34.1057
30>d> 10	11	13	55	0.46	0.84	0.94	51.8645
10>d> 5	6	8	55	0.46	0.84	2.50	24.6168
5>d> 1	7	5	55	0.46	0.84	6.24	23.9862
1>d	4	2	55	0.46	0.84	18.71	10.8188

qb = 1485542.0000 (cm3/sec)
= 3936.6850 (kg/sec)
= 340129.6000 (ton/day)
= 128350.8000 (m3/day)
= 5347.9490 (m3/hour)

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(2) bed load

case : 7
q : 100 (cms)
b : 50.00

range (mm)	dist. (%)	u*c (cm/s)	u* (cm/s)	h (m)	alfa	tau	qb (cm3/s/cm)
>d>200	30	45	57	0.50	0.84	0.08	70.4109
200>d>100	26	35	57	0.50	0.84	0.13	102.5467
100>d> 50	9	25	57	0.50	0.84	0.27	46.0738
50>d> 30	7	18	57	0.50	0.84	0.50	37.7272
30>d> 10	11	13	57	0.50	0.84	1.00	56.9553
10>d> 5	6	8	57	0.50	0.84	2.67	26.8952
5>d> 1	7	5	57	0.50	0.84	6.67	26.1459
1>d	4	2	57	0.50	0.84	20.01	11.7720

qb = 1892635.0000 (cm3/sec)
= 5015.4840 (kg/sec)

= 433337.8000 (ton/day)
= 163523.7000 (m3/day)
= 6813.4870 (m3/hour)

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(2) bed load

case : 8
q : 150 (cms)
b : 61.24

range (mm)	dist. (%)	u*c (cm/s)	u* (cm/s)	h (m)	alfa	tau	qb (cm3/s/cm)
>d>200	30	45	60	0.56	0.84	0.09	99.9872
200>d>100	26	35	60	0.56	0.84	0.15	132.0830
100>d> 50	9	25	60	0.56	0.84	0.30	56.3845
50>d> 30	7	18	60	0.56	0.84	0.56	45.2145
30>d> 10	11	13	60	0.56	0.84	1.13	67.4348
10>d> 5	6	8	60	0.56	0.84	3.01	31.5705
5>d> 1	7	5	60	0.56	0.84	7.53	30.5708
1>d	4	2	60	0.56	0.84	22.60	13.7224

qb = 2920819.0000 (cm3/sec)
= 7740.1700 (kg/sec)
= 668750.7000 (ton/day)
= 252358.7000 (m3/day)
= 10514.9500 (m3/hour)

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(2) bed load

case : 9
q : 200 (cms)
b : 70.71

range (mm)	dist. (%)	u*c (cm/s)	u* (cm/s)	h (m)	alfa	tau	qb (cm3/s/cm)
>d>200	30	45	63	0.61	0.84	0.10	125.6370
200>d>100	26	35	63	0.61	0.84	0.16	156.8169
100>d> 50	9	25	63	0.61	0.84	0.33	64.8631
50>d> 30	7	18	63	0.61	0.84	0.62	51.3259
30>d> 10	11	13	63	0.61	0.84	1.23	75.9514
10>d> 5	6	8	63	0.61	0.84	3.28	35.3578
5>d> 1	7	5	63	0.61	0.84	8.21	34.1498
1>d	4	2	63	0.61	0.84	24.64	15.2979

qb = 3955552.0000 (cm3/sec)
= 10482.2100 (kg/sec)
= 905663.2000 (ton/day)
= 341759.7000 (m3/day)
= 14239.9900 (m3/hour)

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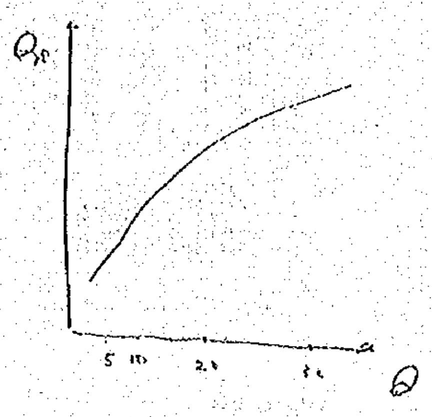
(2) bed load

case : 10
q : 400 (cms)
b : 100.00



range (mm)	dist. (%)	u*c (cm/s)	u* (cm/s)	h (m)	alfa	tau	qb (cm3/s/cm)
>d>200	30	45	70	0.75	0.84	0.12	206.7331
200>d>100	26	35	70	0.75	0.84	0.20	231.9587
100>d> 50	9	25	70	0.75	0.84	0.40	90.0550
50>d> 30	7	18	70	0.75	0.84	0.76	69.3148
30>d> 10	11	13	70	0.75	0.84	1.52	100.8781
10>d> 5	6	8	70	0.75	0.84	4.04	46.3954
5>d> 1	7	5	70	0.75	0.84	10.11	44.5583
1>d	4	2	70	0.75	0.84	30.33	19.8718

qb = 8097651.0000 (cm3/sec)
= 21458.7800 (kg/sec)
= 1854039.0000 (ton/day)
= 699637.1000 (m3/day)
= 29151.5400 (m3/hour)

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-------- Daily ---- Qs(m3/day)=Alfa*Q(m3/sec)**Beta -------

$Q_s = \alpha Q^{\beta}$

Alfa = 903.4110
Beta = 1.1288

-------- Hourly --- Qs(m3/hour)=Alfa*Q(m3/sec)**Beta -------

Alfa = 37.6421
Beta = 1.1288