3-7 Drainage Plan

1. Installation positions of drainage sluices

When the banks are to be constructed for repair of a river, the drainage sluices should be installed for drainage of landside water at the contact area of the existing small water channels flowing down. Especially, there is danger that the downstream area is habitually flooded with the landside water when reinforced for the bank protection by means of leeve or the like. In the case of the Pasing Potrero River, the pipes will be installed on both banks near STA 14900 Santa Juan village on the downstream of Bacolor, and 3 places on the right bank on the upper stream of San Juan. Though the right bank on the upper stream of Mitla and the area near STA13 of Mabical can be the proposed sites, these areas are not adopted because the river bed slope of small water channels in these areas is large and it is more economical to adopt the open level.

2. Size of facilities

For planning the drainage of landside water, size of facilities can be calculated for trial for the ponding when complete hydrologic data are available. However, as the data are incomplete, the cross section was calculated by an informal method and determined from the local conditions. There are 10 to 15 sluice pipes on the right and left banks in the cross-sectional area of by-pass but most of them are small in size and some of them and burried in the ground due to the flood in 1972. Therefore, it is considered that the pipes have no effect on the function.

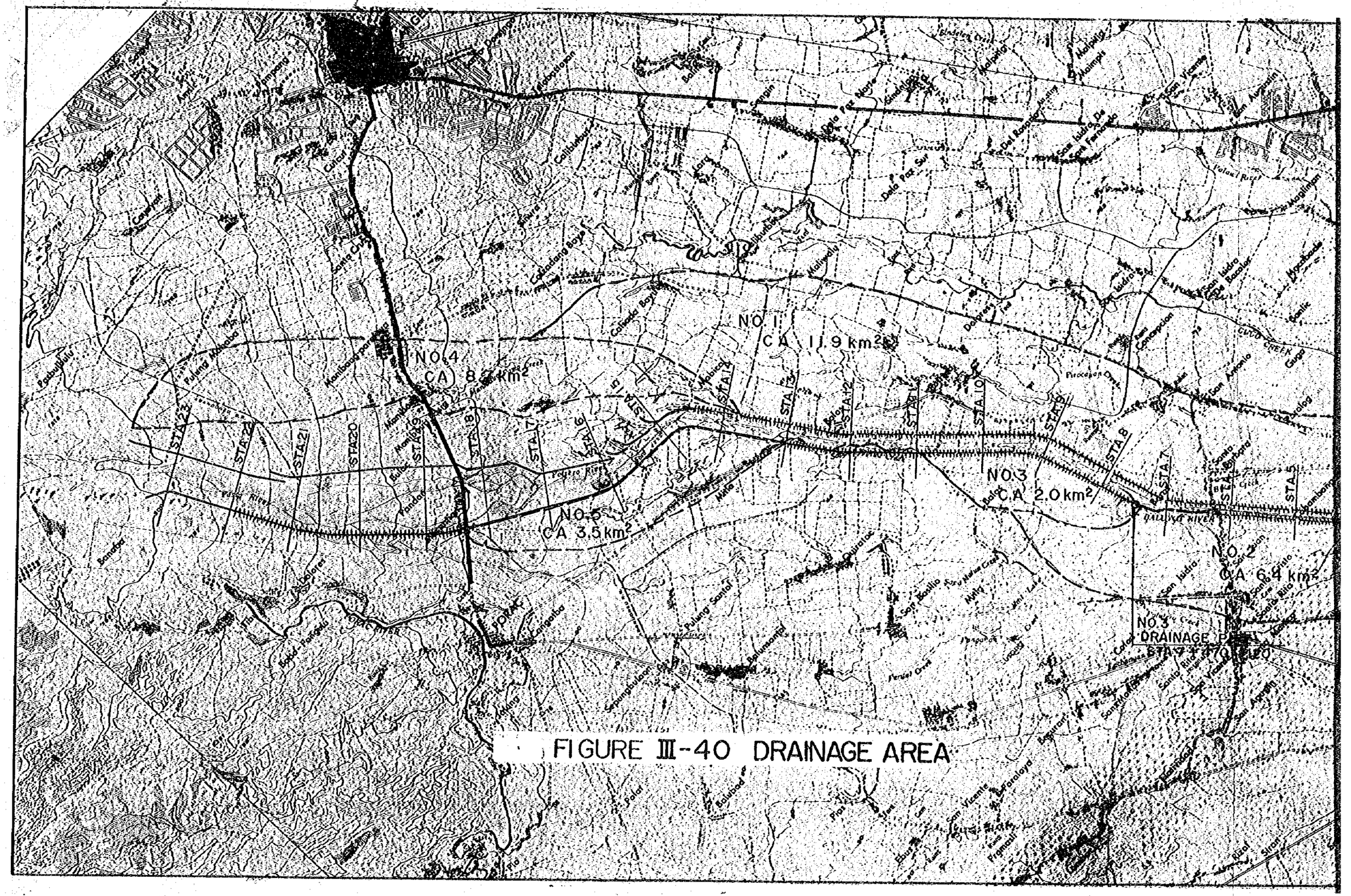


FIGURE III-40 DRAINAGE AREA

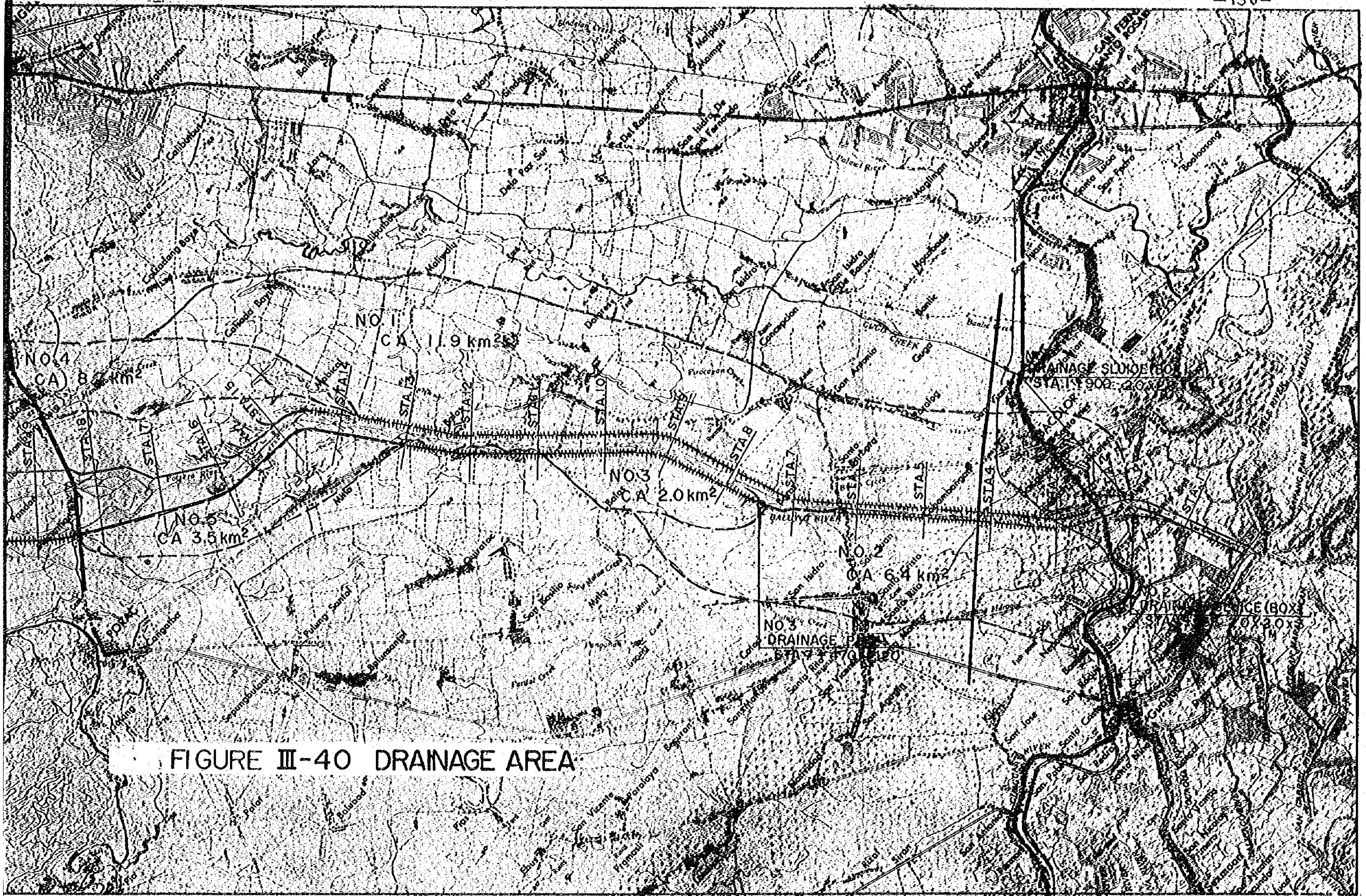


FIGURE III-40 DRAINAGE AREA

In addition, the drainage sluice pipes of ϕ 600 are installed in the national high way of Bacolor. However, as the pipes flowed down by flooding more than 50 cm on the road under conditions in the same year, it is not considered that its size affects the designed areas on the downstream. Therefore, the plan will be developed by nearly neglecting the effects of both roads.

Generally, when the cross sectional area of sluice pipes are to be determined, the following factors should be taken into account.

(i) The maximum flow velocity in sluice should be controlled within 1.0 to 3.0 m/s.

(ii) In the case in Japan, take 0.8 to 1.8 m^2/100 ha and determine it according to the river slope as follows:

Less than 1/5,000 : 0.6 to 0.7 m^2/100 ha

1/5,000 to 1/1,500: 1.0 to 1.3 m^2/100 ha

More than 1/1,500 : 1.5 to 3.0 m^2/100 ha

(iii) Tarbot Formula

When rainfall is assumed to be 4 in/hr,

$A = C.M^{3/4}$ (ft^2)

where, M: Drainage area

C: Topography constants of drainage sections

Steep rocky area: C = 1

Wild hills with gentle slope: 2/3

Width is larger than length: 1/2

Farming land whose length is 3 to 4 times as large as the width: 1/3

Flat land: 1/5

TABLE III-18

	No.1	No.2	No.3
STA. Point	L. 1 + 900	R. 1 + 856	R. 7 + 470
M (km^2)	23.5	9.7	2.0
C	1/5	1/5	1/5
A (m^2)	11.9	6.4	2.0
Used Section (m^2)	$2^m \times 2^m \times 3$ = 12.0 m^2	$2^m \times 2^m$ 2 = 8.0 m^2	ϕ 1,650 x 1 = 2.14 m^2

The cross-sectional area will be determined for each point as stated above.

The ponding period of 2 to 3 days is allowable for the cross-sectional area of 0.5 to 1.0m. If the ponding period is above the allowance, the crops will be damaged to extent of nearly no harvest.

3. Landside water drainage plan

The ponding is calculated from a continuous concept that change of ponding volume is a difference between the landside inflow volume and the sluice pipe outflow volume at some time intervals.

TABLE III-19

Time	Inflow Discharge (m^3/s)	Outflow Discharge (m^3/s)	Landside Water Level (m)	Channel Water Level (m)	Inundated Volume (m^3)
t_1	i_1	o_1	h_1	H_1	V_1
t_2	i_2	o_2	h_2	H_2	V_2

(2) Drainage capacity curve (Q - (h, H) curve)

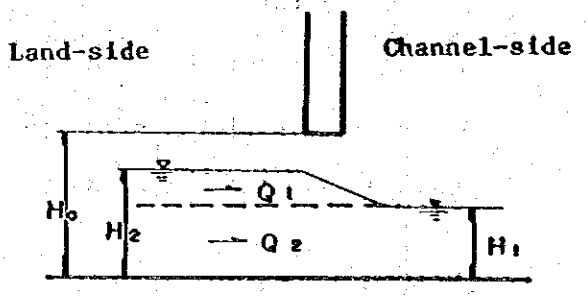
In the case of sluice pipe, it is calculated from the forms of

$B = 2 \times 3 = 6.0m$

$Ha = 2.0m$

$Q = Q_1 + Q_2$

FIGURE III-41



When H_1, H_2 and B are taken as the river side water level, landside water level and width,

$$Q_1 = C_1 \cdot \frac{2}{3} B \sqrt{2g(H_2 - H_1)} \cdot (H_2 - H_1)$$

$$Q_2 = C_2 \cdot B \cdot \sqrt{2g (H_2 - H_1)} \cdot H_1$$

where, $C_1 = 0.62$ and $C_2 = 0.53$.

Fig. IV-38 is prepared based on the above calculation.

(3) Landside water inflow hydrograph (i - T curve)

From the rainfall strength formula in separately compiled "Hydrology", the landside inflows are given 48, 61 and 67mm for the pertinent years of 20, 50 and 80.

In this case, the reaching time is 4.0 hrs.

The rational formula is,

$Q = 0.2778\ f.r.A$

and t is put in the form of $t_2 - t_1 = t$

$$V_2 - V_1 = \left(\frac{i_1 + i_2}{2} - \frac{O_1 + O_2}{2} \right) \cdot t$$

where, the landside water ponding volume is expressed with a function of the landside water level h.

$$V = f(h)$$

A drainage volume O of the sluice pipes will be decided by the landside water level h and the riverside water level H after determination of the cross-sectional area.

$$O = g(h.H)$$

$$f(h_2) - f(h_1) = \left[\frac{i_1 + i_2}{2} - \frac{g(h_1.H_1) + g(h_2.H_2)}{2} \right] \wedge t$$

For that purpose, the calculation is developed for

(1) Riverside water level - time curve: H - T

(2) Landside inflow discharge - time curve: i - T

(3) Landside water level - ponding volume curve: h - V

(4) Drainage capacity curve for sluice pipes: O - g(h.H)

at the o.1 point on the left bank of STA1 + 856 in the preceeding item.

(1) Riverside water level - time curve (H - T curve)

As the data are scarcely available, it is determined to be 7 hrs by using the formulas of Rziha and Kraven and also the slope and distance up to the relevant point. From the respective peak levels at the time of 410, 600 and 900m^3/s with the relevant probability of 1/5, 1/20 and 1/80, it is assumed that the level will continue for 3 days, and a triangle wave form is converted from the H-Q curve to the H-T curve.

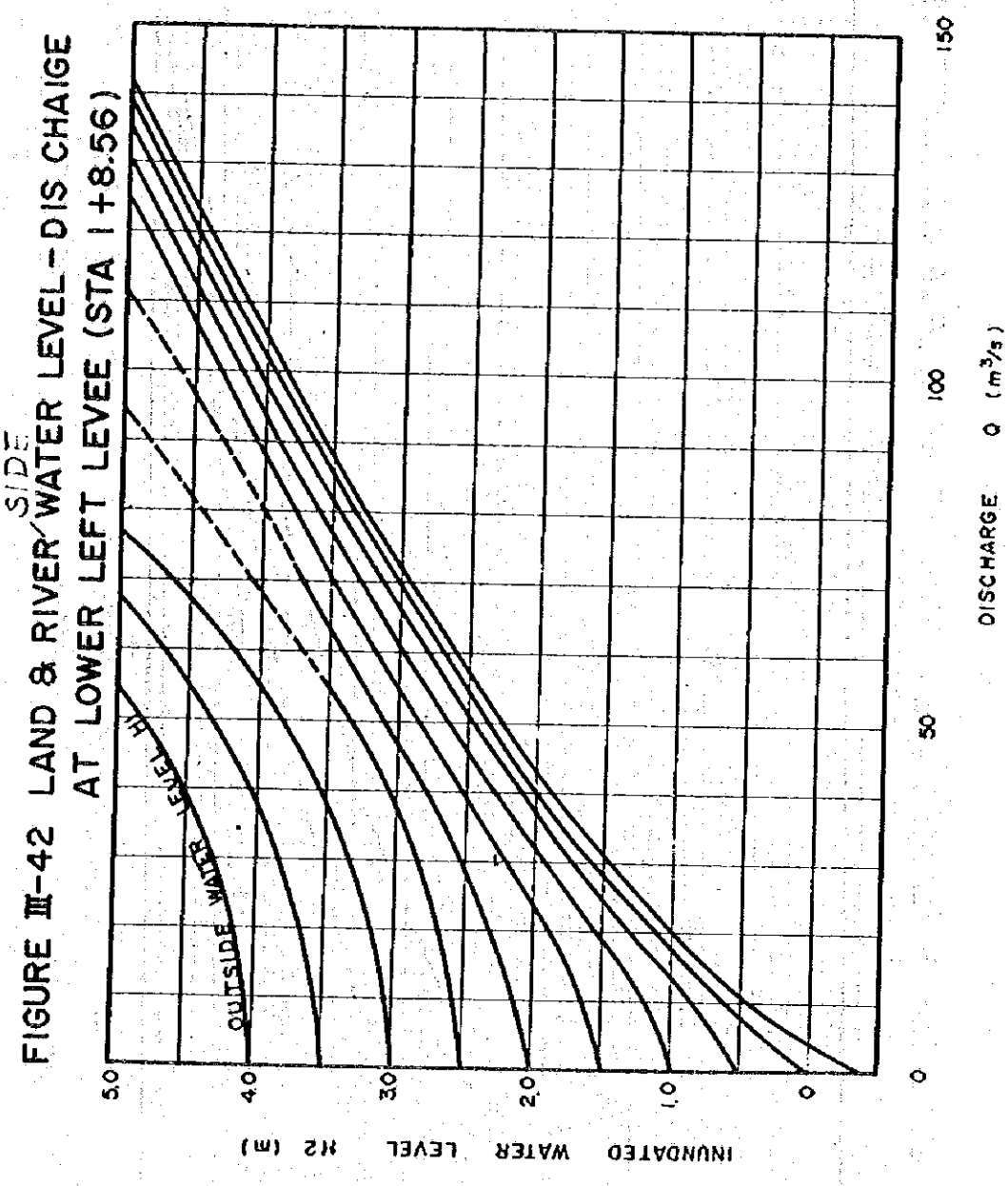


FIGURE III-42 LAND & RIVER SIDE WATER LEVEL - DIS CHAIGE AT LOWER LEFT LEVEE (STA 1+8.56)
OUTSIDE WATER LEVEL H1
INUNDATED WATER LEVEL H2 (m)
5.0
4.0
3.0
2.0
1.0
0
0
50
100
150
DISCHARGE Q (m³/s)

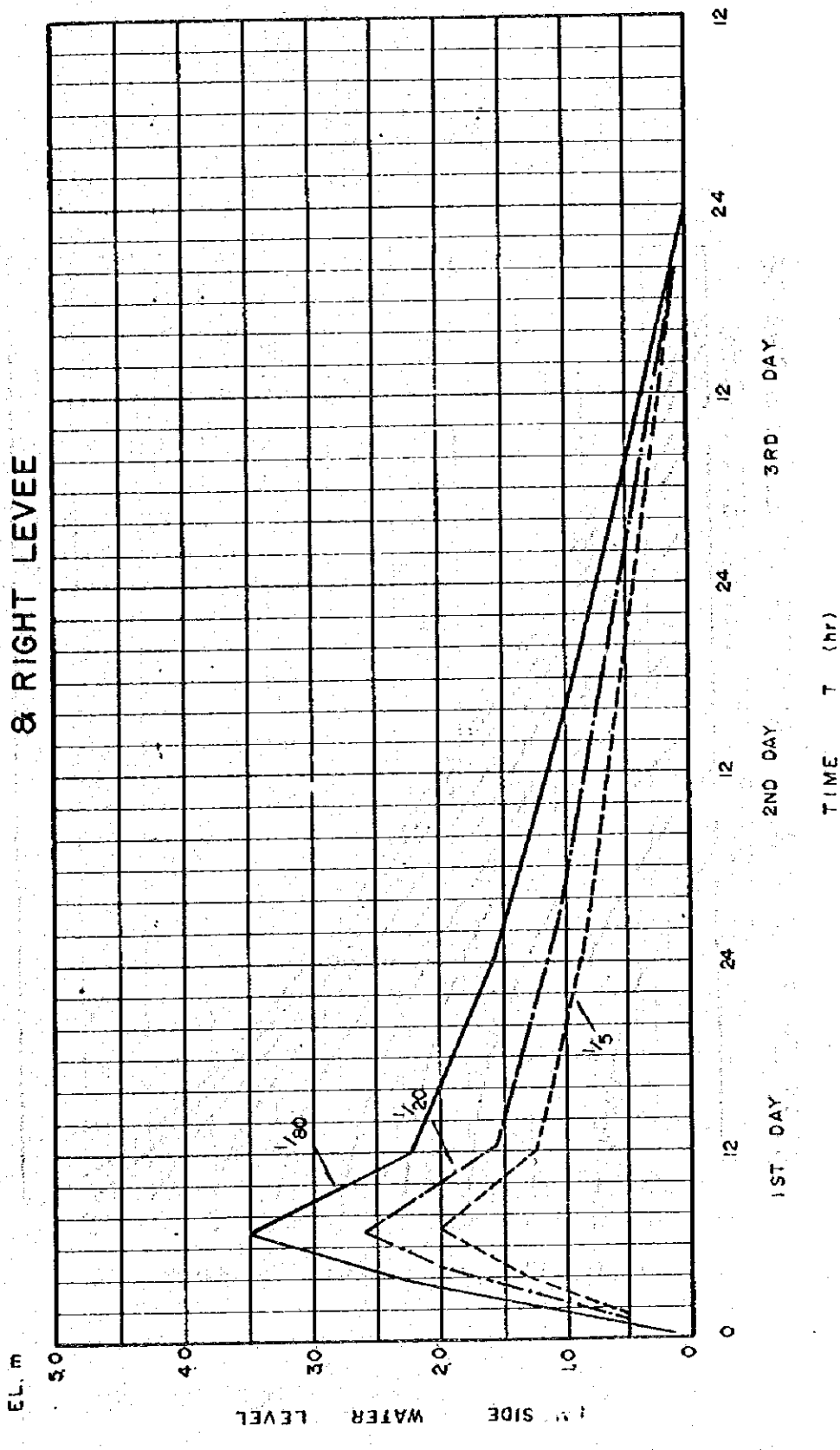


FIGURE III-43 LAND SIDE WATER LEVEL-TIME COURVE AT LOWER LEFT & RIGHT LEVEE

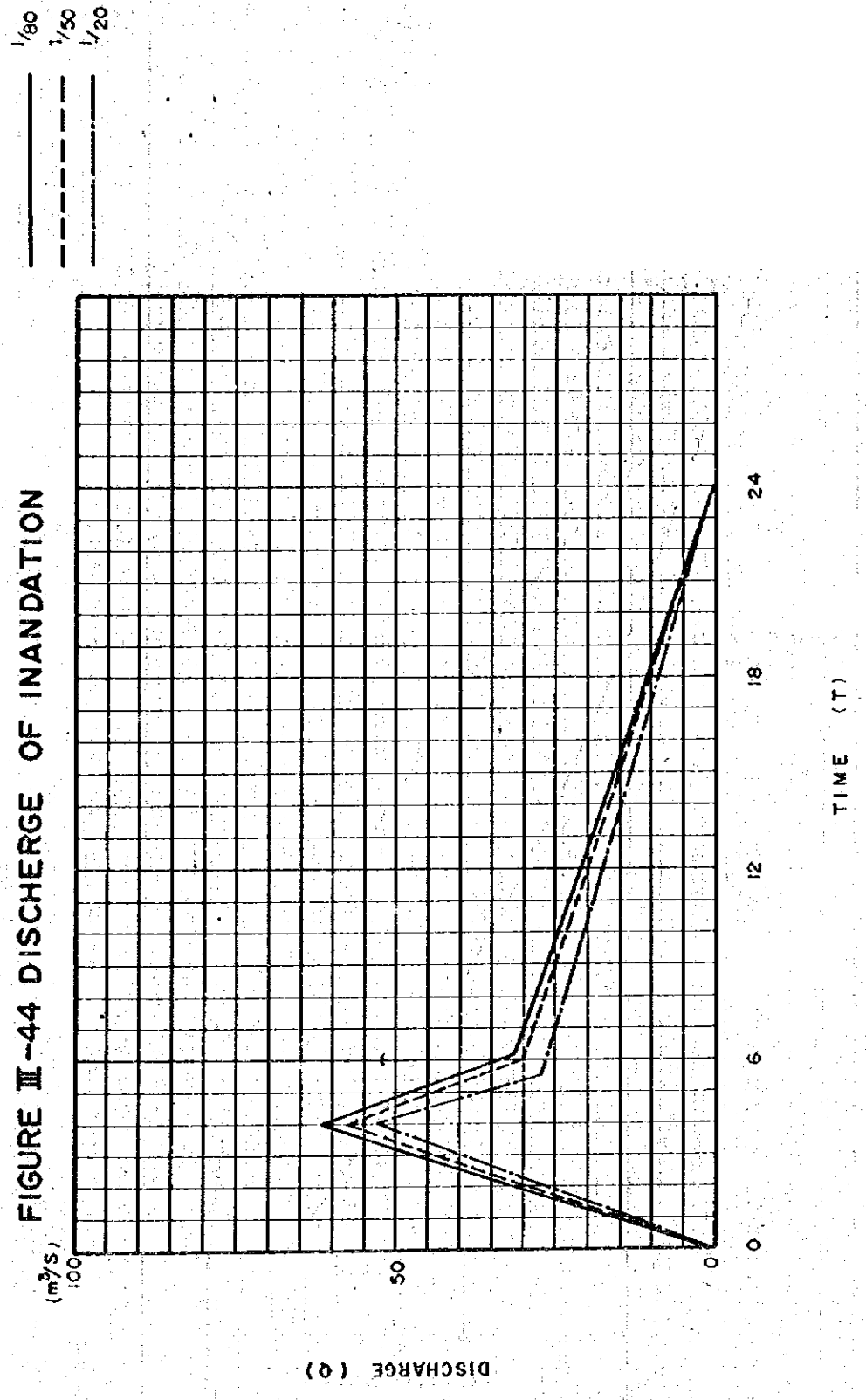


FIGURE III-44 DISCHERGE OF INANDATION

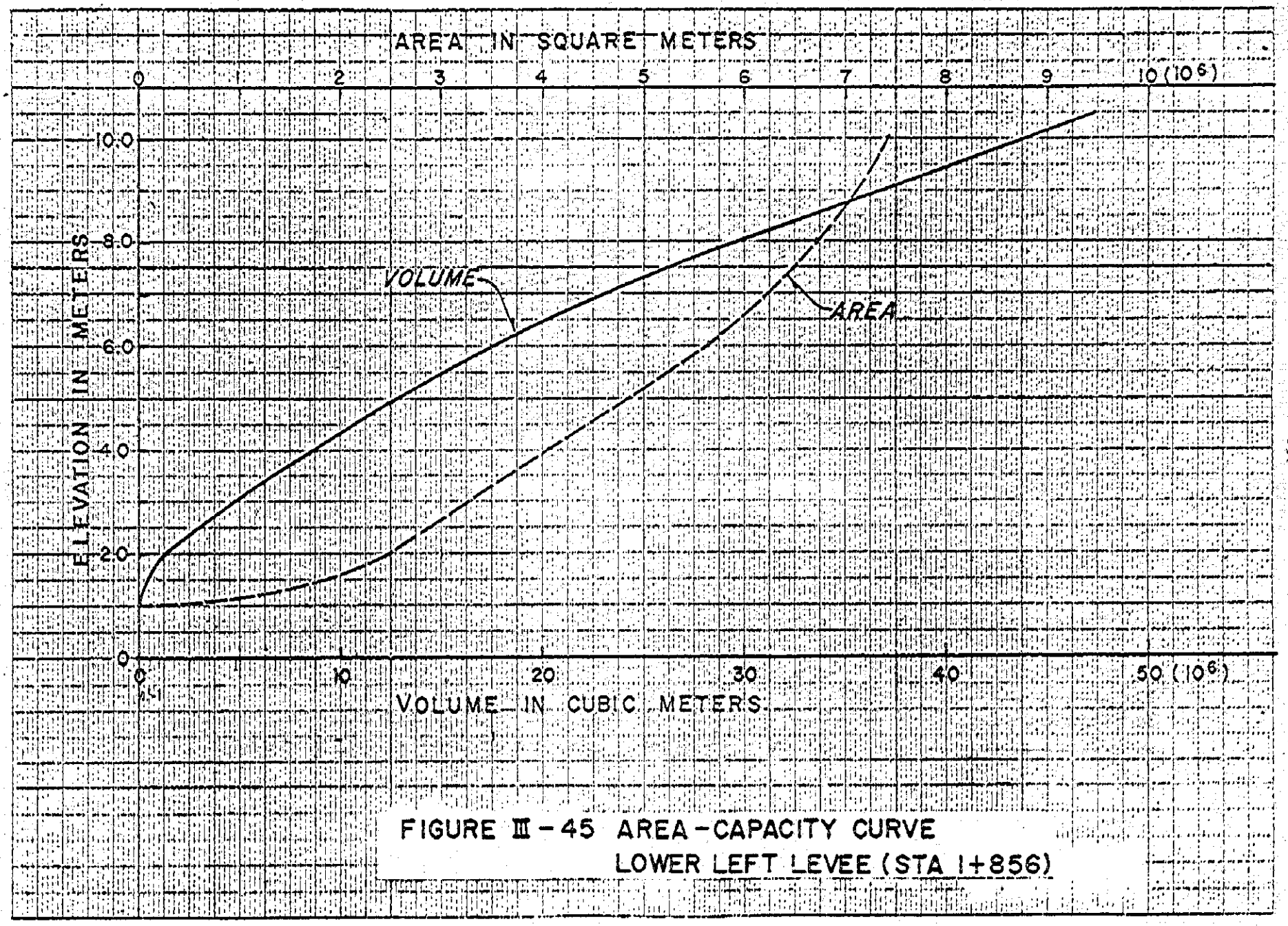


FIGURE III-45 AREA-CAPACITY CURVE
LOWER LEFT LEVEE (STA 1+856)

where, Q: Maximum flow (m^3/s)

f: Flowout coefficient (=0.6)

r: Average rainfall strength (mm/h) within the reaching hour.

A: Water collecting area (km^2)

With regard to the hydrograph, the landside inflow is counted as a daily rainfall in the form of triangle wave by combining the reaching time of 3.5 hrs and the peak time.

(4) Landside water level - flood volume curve (h - V curve)

The above-sea-level capacity curve of the relevant point will be prepared based on the 1/5,000 topographical map.

4. Calculation results and conclusion

The results of calculation by a computer based on the numerical values in the preceeding item are shown in the tables and figures in the following pages. The results are as summarized in the table below.

TABLE III-20

Discharge Probability	Outer Water Level Probability	Max. Inner Water Level	Ponding Time (hr)	
			1.0 m upper	1.5 m upper
1/80	1/80	EL. 2.08	45 hr	31 hr
	1/20	1.97	37	21
	1/5	1.85	35	20
1/50	1/20	1.92	37	23
	1/5	1.80	32	19
1/20	1/20	1.84	37	21
	1/5	1.74	31	17

FIGURE Ⅲ-46-1 DIAGRAM OF INUNDATED FLOOD (Q = 1/80, H = 1/80)

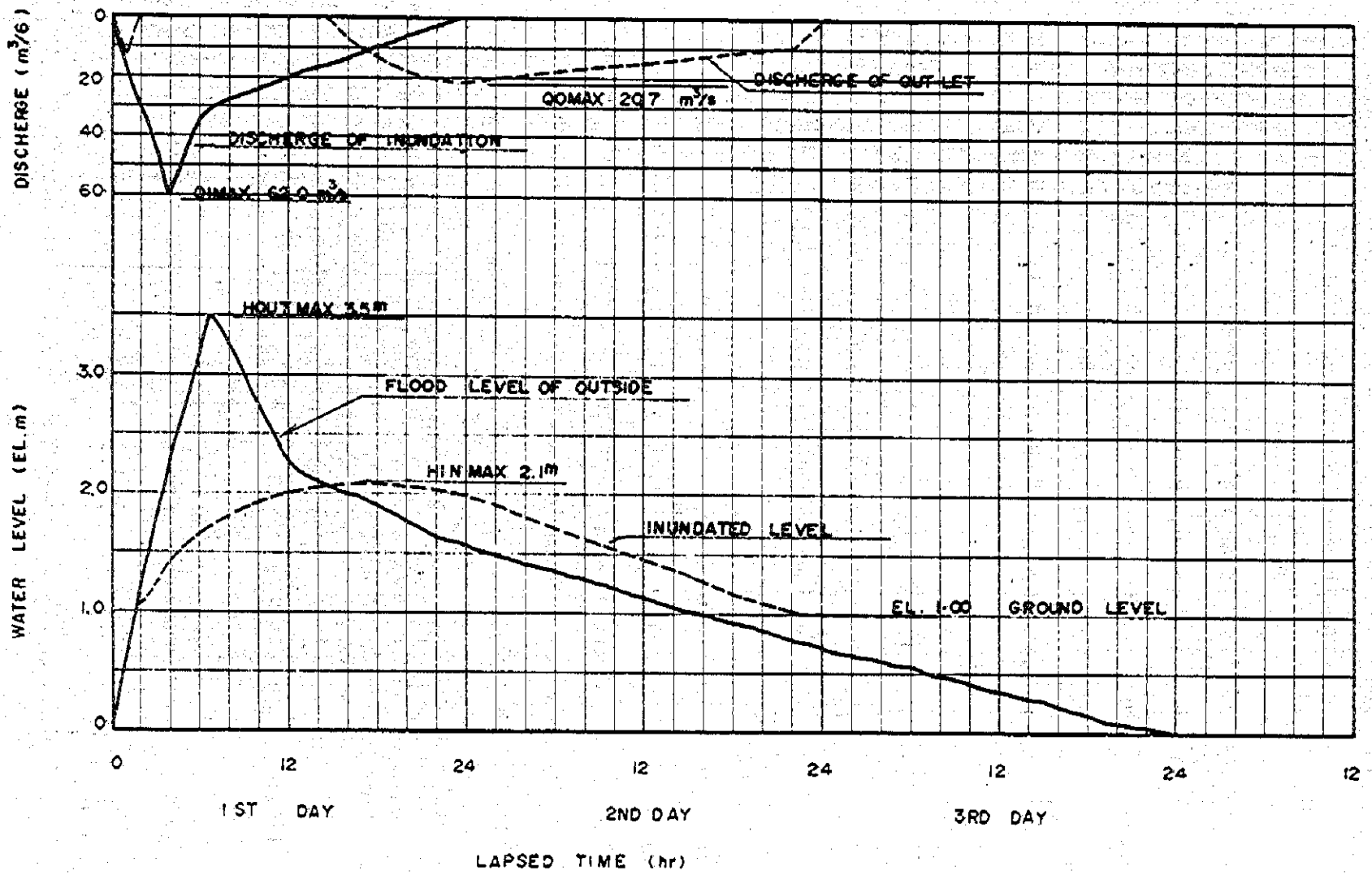


FIGURE III-46-2 DIAGRAM OF INUNDATED FLOOD (Q = 1/80, H = 1/20)

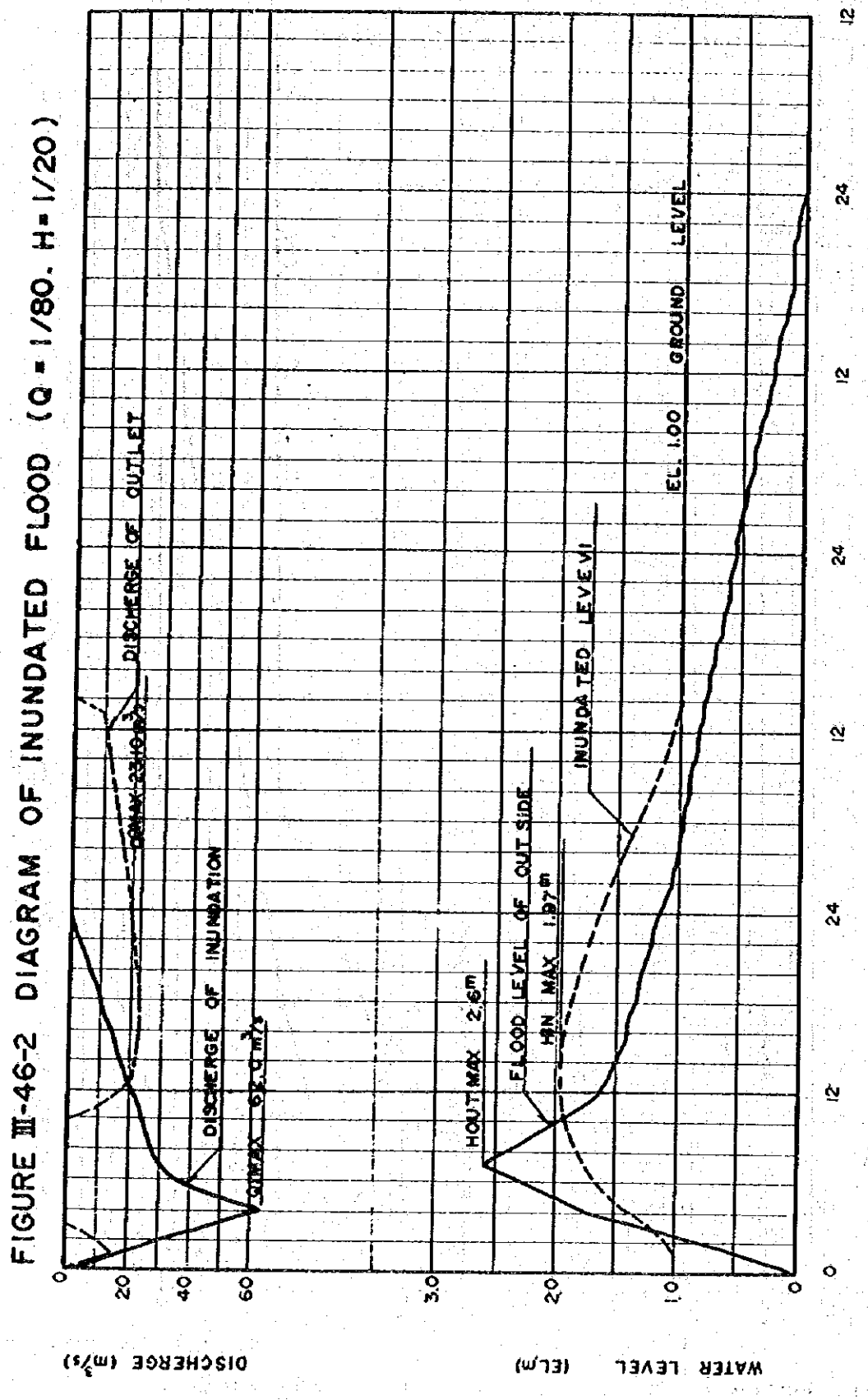


FIGURE Ⅲ-46-3 DIAGRAM OF INUNDATED FLOOD (Q=1/80. H=1/5)

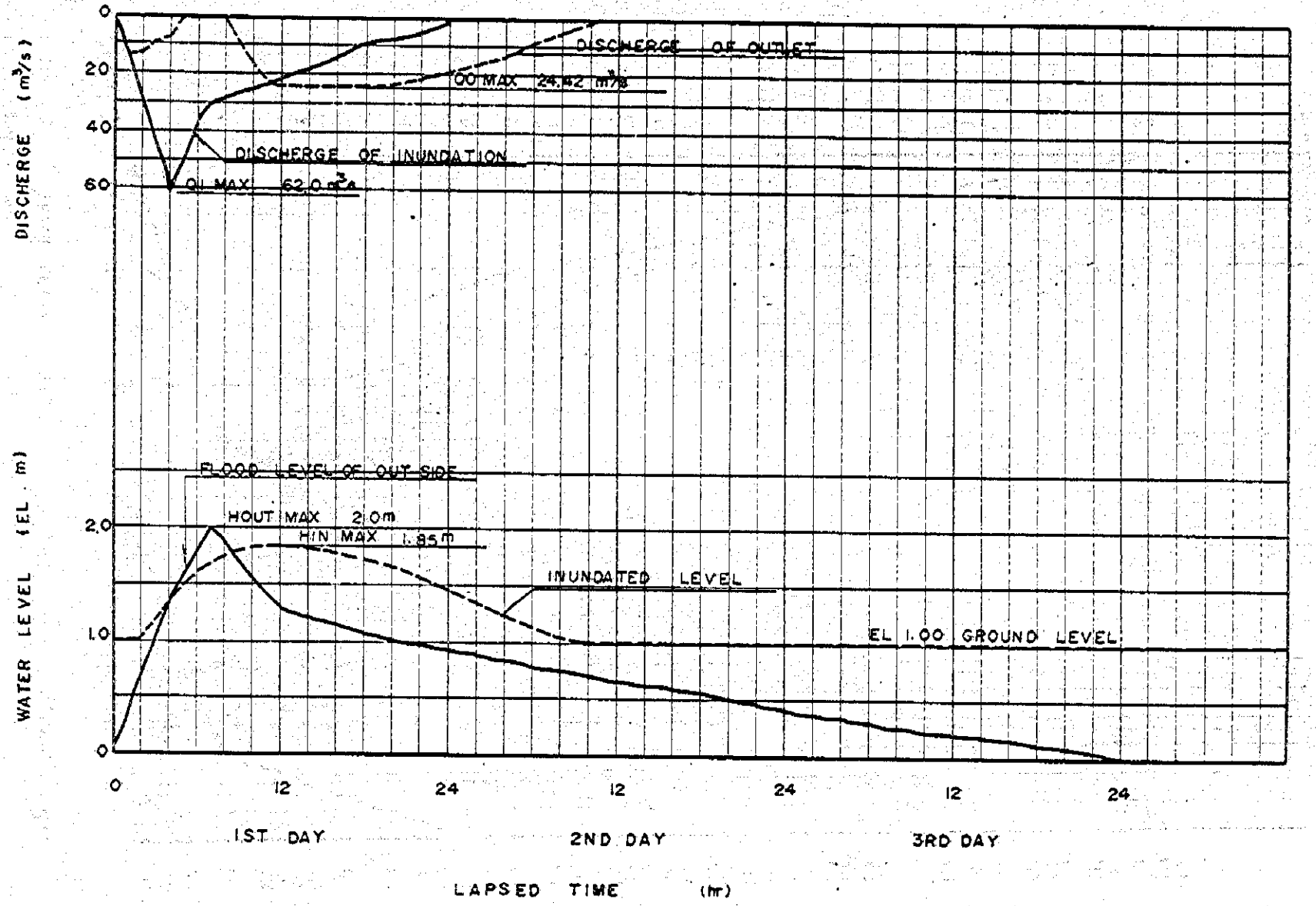


FIGURE III-46-4 DIAGRAM OF INUNDATED FLOOD (Q = 1/50, H = 1/20)

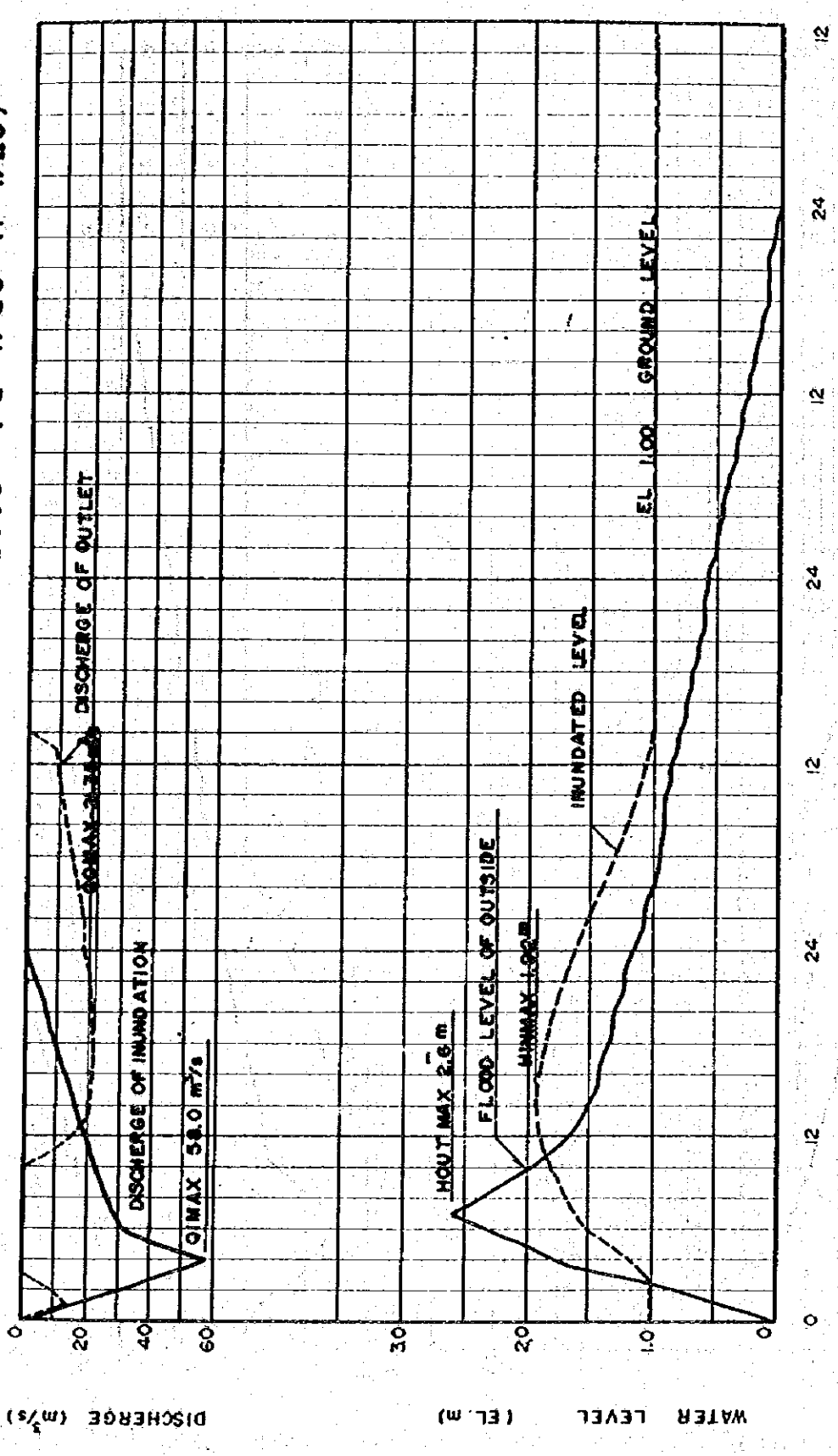


FIGURE Ⅲ-46-5 DIAGRAM OF INUNDATED FLOOD (Q=1/50·H=1/5)

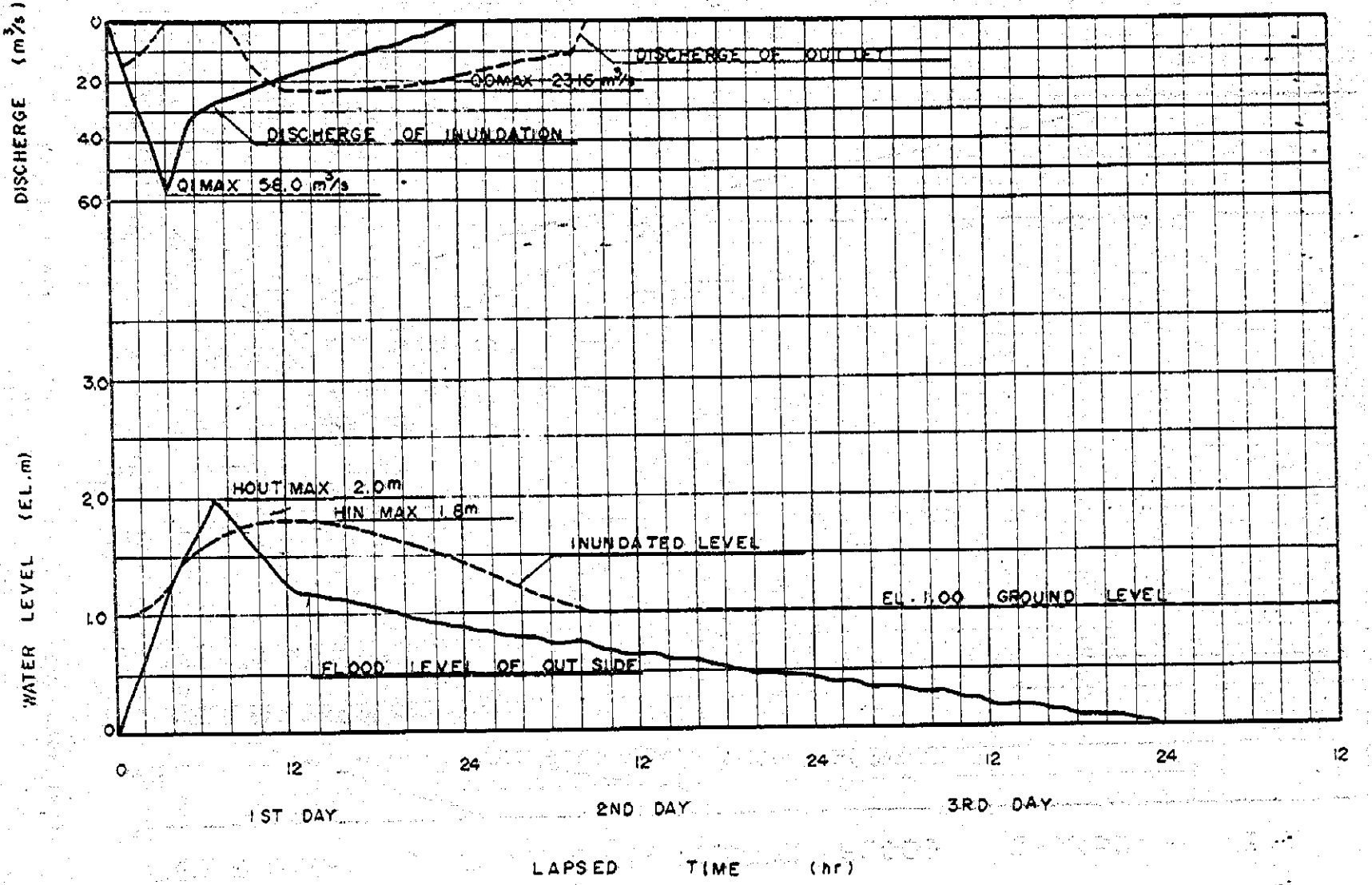


FIGURE III-46-6 DIAGRAM OF INUNDATED FLOOD (Q=1/20, H=1/20)

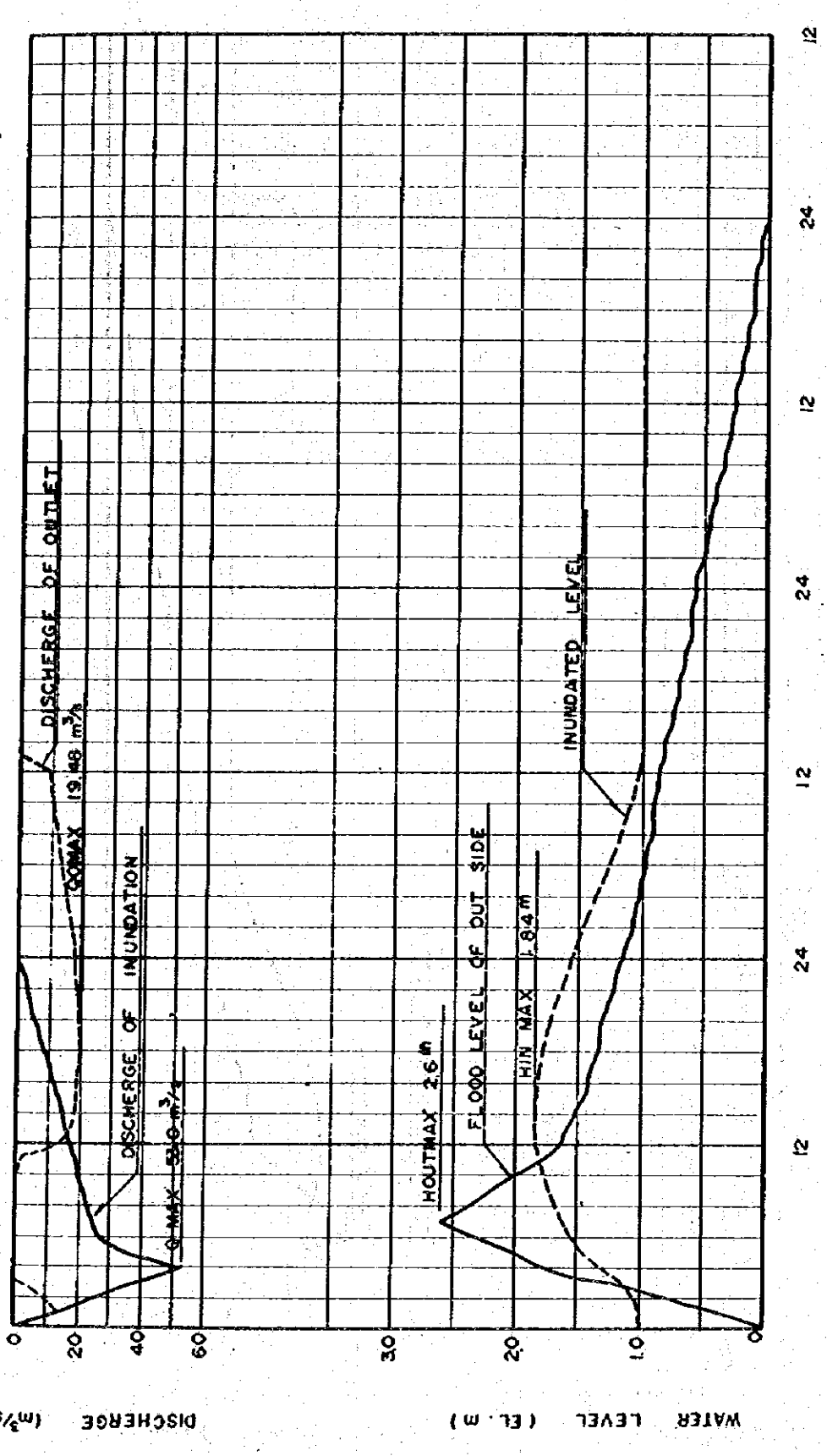
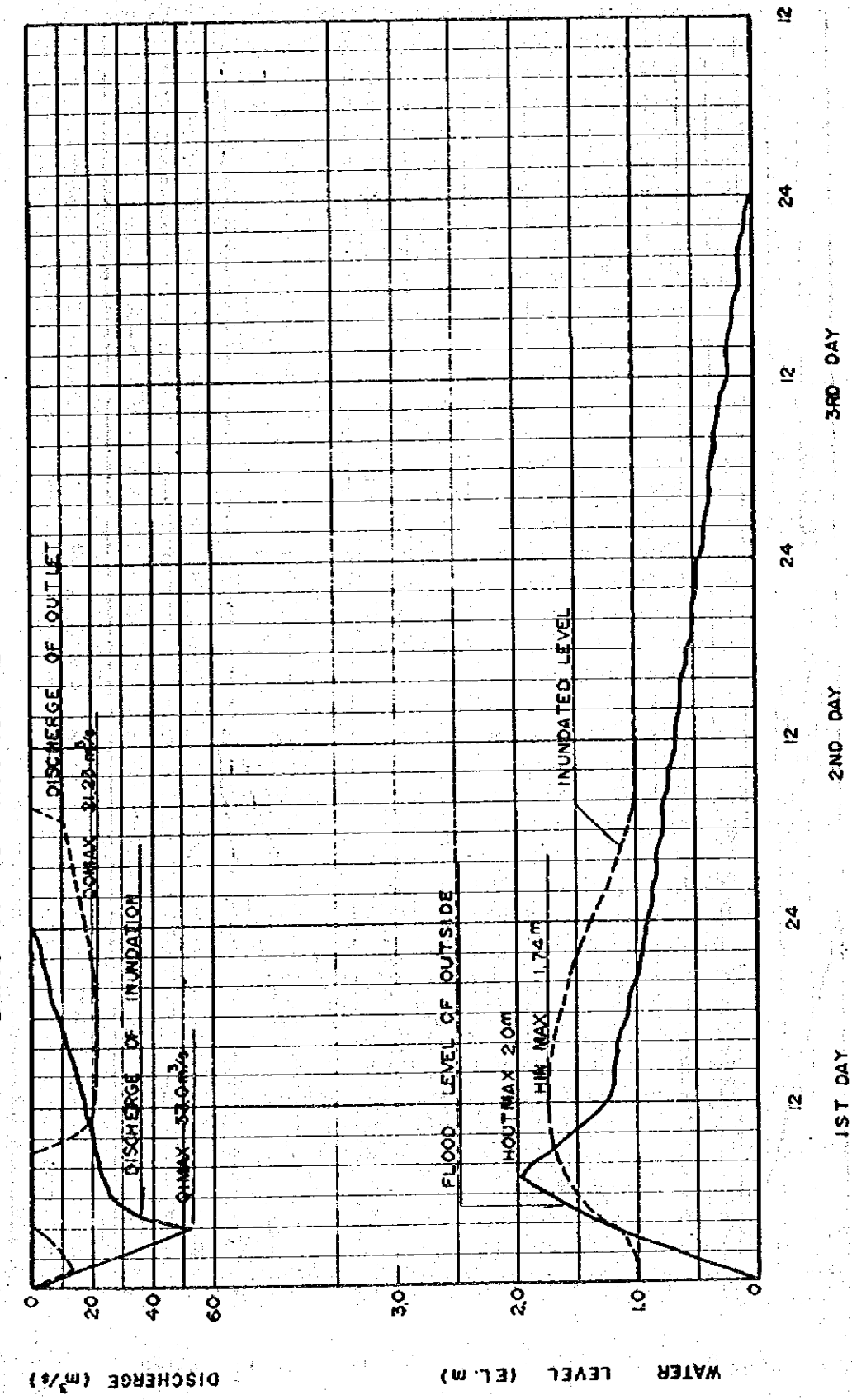


FIGURE III-46-7 DIAGRAM OF INUNDATED FLOOD (Q = 1/50, H = 1/20)



(1) Designed flow

The landside inflow wave form was calculated by the peak flow according to the rational formula. At present, however, there exists a water channel, 25 meter wide and 1.0 meter deep. It is corrected by the H-Q curve of this water channel to review the hydrograph.

In addition, the riverside water level was prepared from the H.Q curve for the same point. Regarding this low water area, the flow from the peak point and the low water point are assumed based on the actual results in 1972.

Among these calculated results, the reaching time for the riverside water was calculated by the formulas of Kraven and Rziha but it is considered that the further review is necessary.

(2) Ponding water depth and time

The ponding water depth and time are as shown in the table above, roughly within 48 hours and are satisfactory even above the ponding depth, more than 1.0m. However, these data should be re-examined again based on the actual measurement data in future although it is depending on the landside inflow hydrologic data.

(3) No.2 and No.3 points

No calculation was made for these points. However, as the drainage areas of both points are smaller than No.1 point and the reaching times are shorter than No.1 point, conditions are on the safety side. Therefore, the

the calculation was omitted and only the drawings will be furnished.

IV CONSTRUCTION PLAN AND IMPLEMENTATION SCHEDULE

4-1 General

(1) Stretch and works

This work schedule has been established to implement river improvement in a stretch of 27 km consisting of a valley (STA. 27 - STA. 23), a sand arresting basin (STA. 23 - STA. 15) and a river channel (STA. 15 - STA. 0). The main work items are presented as follows.

1) Preparation works

- Site office
- Field office

2) Main works

- Embankment work
- Excavation work
- Revetment work
- Groyne work
- Groundsel work

3) Additional works

- Sluice work
- Retaining wall work

(2) Work time and the number of workdays

The climate in the Philippines can be classified into two pronounced seasons as follows.

- Rainy season from May to November (seven months)
- Dry season from December to April (five months)

As shown in TABLE IV-10 , rainfall is hardly experienced in a dry season. The work time shall be scheduled upon various climatic and riparian conditions such as rainfall, existing water level and flow velocity. The stretch for river improvement is characteristic of river-bed water. And surface flow is not observed therein. Therefore, work time in this project can be determined judging from only reinfall condition, because riparian conditions are already agreeable.

From the viewpoint of ease of construction and administration, embankment work included in main works shall be done in a dry season which is advantageous for adjustment of moisture ratio, rolling compaction and transportation of materials.

Since sand and soil excavated from the river-bed will be utilized for embankment materials, excavation work shall be implemented accroding to the embankment work schedule.

Wet masonry and consolidation works included in the revetment work shall be also done in a dry season because concrete work will be attended.

Revetment, gabion cylinder and groyne works are not so subject to rainfall conditions as embankment and concreting works. However, those works are preferable to be done in a dry season, from the viewpoint of disposal of surplus soil and transportation of materials. In conclusion, all main works shall be implemented in a dry season.

The number of workdays in a month in estimated at 25 days/month, excluding four off-days and one day for rain.

(3) Work period and priority

Five-year work period is the most recommendable, taking into account the balance between the estimated volume and facility and/or equipment.

Considering the existing conditions and damages in the past, work process shall be determined so that works in the project area including the valley, sand arresting basin and river channel will be proceeded in the order of priority.

The places emergent to be improved are presented in the order of priority as follows.

i) Sand arresting basin (STA.24 - STA. 21+800)

In this stretch, the most problematic area, flow during a flood goes down out of the river channel. The channel shall be excavated immediately to improve its stability.

ii) Sand arresting basin (STA.18+700 - STA.18+100)

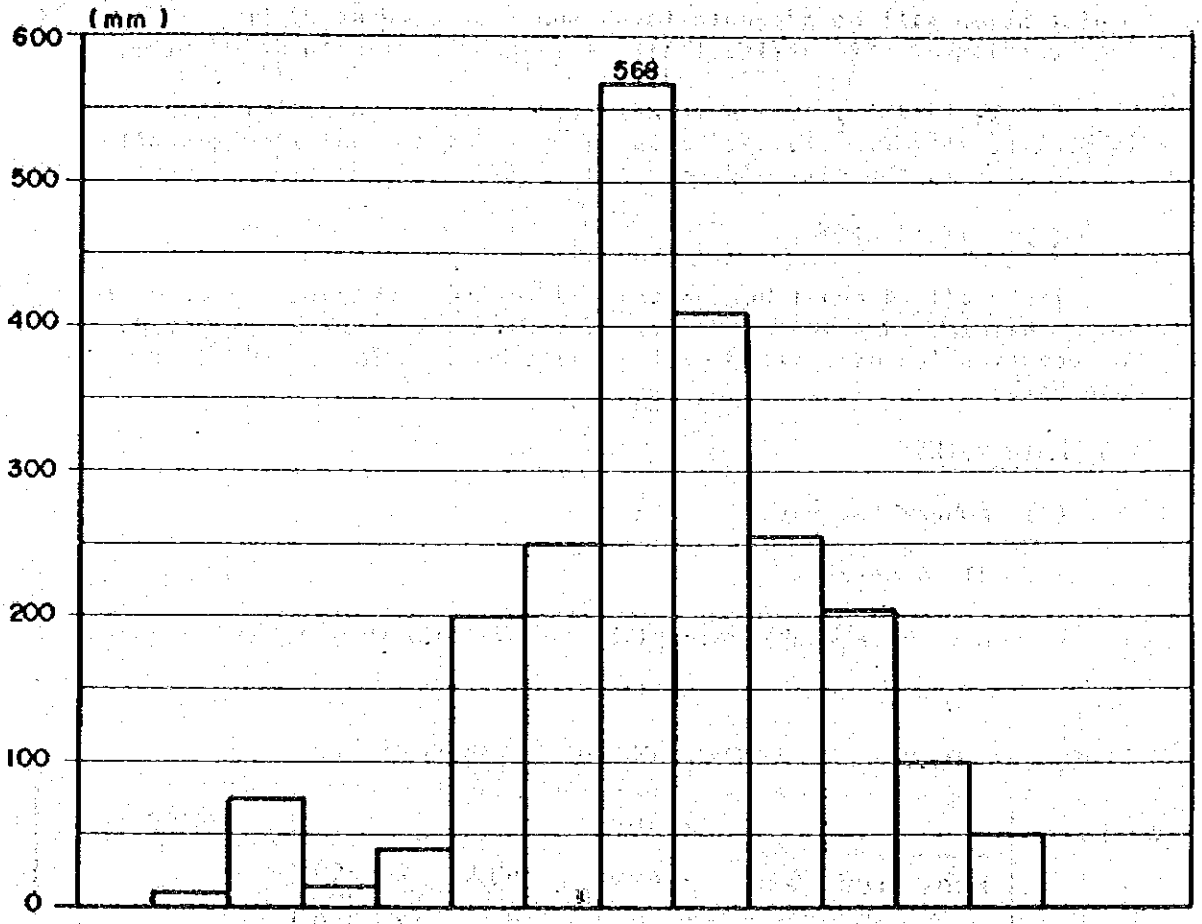
In the sand bar near Sta. 18+400 exist dozens of houses. Ring levee around the community shall be constructed to protect the inhabitation from flood damages.

iii) River channel (STA.16 - STA. 0)

First of all, excavation and embankment works shall be done in the water channel with a low flow capacity. Subsequently the concave side of a river bent and the levee partly damaged by landside water shall be improved and the whole river channel in this stretch shall be completed.

TABLE - III - 21 MEAN RAINFALL OF EACH MONTH

STA. CRUZ , PORAC



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AOG	SEP	OCT	NOV	DEC	TOTAL
1969		16.8	20.7	4.8	28.7	91.5	203.2		263.3	102.7	81.5	22.7	—
70	T		4.5	30.0	30.4	236.6	257.0	273.4	257.7				—
71	20.0	2.5	23.0	3.1		296.8	518.0	43.3	339.2	411.8	172.9	84.4	(1914.0)
72	24.9	17.9	20.2	29.4	133.2	327.2	2274.5	916.6	171.0	15.2	13.7	12.6	4.092.0
73	1.0	T	2.0		33.0	131.3	331.7	406.6	219.1	226.9	75.6	4.8	(1.462.2)
74	2.0	23.1	52.0	165.4		379.7	214.1	665.6	152.4	345.6	311.8	56.7	(2.408.3)
75	19.2	28.5	6.6	17.4	139.5	175.1	123.4	286.2	121.6	321.6	51.2	127.2	1.417.3
76		14.3	14.6	54.6	869.2	485.9		319.2	328.8	16.6	2.8	39.2	2.345.0
77	21.9			18.4	156.4	151.2							
TOTAL	89.0	103.1	103.1	323.3	1410.6	2.273.3	3981.9	2860.9	2053.1	1.440.4	709.1	347.0	
MEAN	12.7	74.7	12.9	40.4	201.5	252.6	568.8	408.7	256.6	205.8	101.3	49.6	2.185.6

4-2 Preparative Work

Preparative work consists of site office construction and field office construction.

(1) Site office

One site office constructed for the convenience of work administration will be adequate for a short stretch of 27 km. The construction of site office shall be launched prior to main works.

In the vicinity of a site office, concrete and soil testing laboratry, factory, storage-house and parking lot shall be installed in addition to the site office.

(2) Field office

Field office shall be constructed to stock temporarily utensils and materials, in which space for clerical work shall be prepared. The construction of a field office shall be done in accordance of Main Works.

4-3 Main Works

(1) Embankment work

1) General

Places to be embanked are given in the following table.

TABLE III-22 LOCATION OF EMBANKMENT

Works	Location		Quantity
New Embankment	Left, Right,	STA. 0 + 50 ~ STA. 2 + 500	V = 443,073 m^3
	Right,	STA. 13 + 500 ~ STA. 18 + 400	
	Left,	STA. 14 + 500 ~ STA. 23	
	Right,	STA. 22 + 100 ~ STA. 23 + 500	
Widening	Left,	STA. 2 + 500 ~ STA. 6 + 550	V = 197,977
	Right,	STA. 2 + 500 ~ STA. 7 + 700	
	Right,	STA. 10 + 950 ~ STA. 16	

In principle, sand and soil excavated from a river-bed shall be used as embankment materials. However, river-bed materials are sandy soil with a low viscosity of 2 or 3%. In case that it is necessary to arrange soil texture (C and ϕ) and mixture of grain-size, materials with a high viscosity from a borrow pit shall be mixed in embankment materials.

ii) Construction

Materials obtained from river-bed excavation shall be stocked temporarily in a stockyard to adjust moisture ratio.

Bulldozer (21 t) for land grading and dozershovel (1.2 m^3) for loading shall be prepared in the stockyard.

Embankment materials shall be conveyed from the stockyard to the embankment site by a dump truck (8.0 t).

Construction method at the site can be classified into the following two cases.

FIGURE-III-47 NEW EMBANKMENT

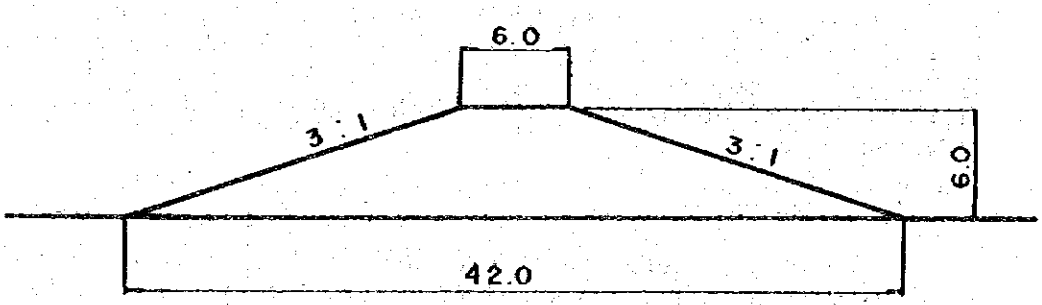
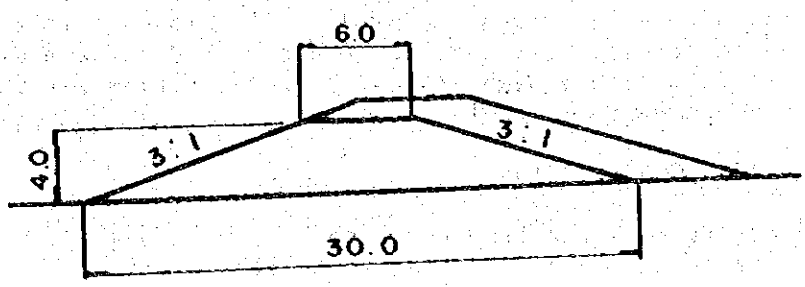


FIGURE-III-48 LEVEE WIDENING



As to the new embankment, the materials shall be directly dumped on the filling ground by a dump struck.

After surface grading by a bulldozer, rolling compaction shall be done by an automatic vibration roller (6t).

As to the levee widening, it will get difficult for a dump struck to access to the filling ground in the proportion of the height of a filling ground because of a narrow filling ground. Therefore, materials shall be filled up temperarily in the vicinity of the filling ground by a dozer shavel (1.2 m^3). After surface grading by man power, rolling compaction shall be done with a handy vibration roller, and in addition a soil compactor shall be prepared. The bench cut work of the existing levees shall be implemented prior to the levee widening work.

(2) Excavation

Excavation includes low-water channel excavation which commands a majority in quantity and excavation for river bed protection work, both of which will be executed to excavate gravels. Mechanic schedule shall be divided into two types; namely, excavation-on-land and excavation-in-water on the ground that in a dry season underground water level is so high due to underflow water though surface runoff is scarecely found in the existing river channel.

i) Excavation-on-land

Excavation-on-land will be applicable to the case that water depth is less than 50 cm. A Bulldozer (21t) shall be operated for excavation and compaction. Loading shall be done by a dozer shovel (1.2 m^3). And sand and soil loaded by a dozer shovel shall be conveyed to the stockyard as embankment materials by a dump truck (6t).

ii) Excavation-in-water

According to the soil data B.H.1-7 and 1-8, underground water reaches up to 1.0 - 1.5 m under the ground. The stretch to which excavation-in-water will be applied covers the sand arresting basin (Sta.20+400 - Sta.20+850) and the confluence with Gua-gua River. Excavation and loading shall be done by a backhoe (1.2 m^3). A bull-dozer (21t) shall be also prepared in the site. Sand and soil excavated shall be conveyed to the stockyard by the same way as excavation-on-land.

(3) Revetment work

Revetment work consists of the following two types;

- Wet masonry (high-water channel revetment in the total length)
- Gabion cylinder (low-water channel revetment at the concave side of a bent and landside revetment)

i) Wet masonry

In order to protect the slope surface from gully erosion, wet masonry work shall be done according to the schedule of embankment work.

Cobble stones for wet masonry purchased in a market shall be temporarily deposited in the vicinity of the site. Conveyance and setting shall be executed by man-power.

Concrete for wet masonry and foot protection shall be mixed by a portable mixer (0.2 cu.m./batch). Piles with a length of 2.5 m for foot protection shall be driven by man-power.

ii) Gabion cylinder

Gabion cylinder in ϕ45 shall be used. Wire (#8) wearing and cobble stone setting shall be prepared by man-power. Steel wires shall be produced at a factory in the site office. Boulder shall be set at the site.

Brushwood shall be set at the bottom of gabion cylinder to prevent drawing-out of sand.

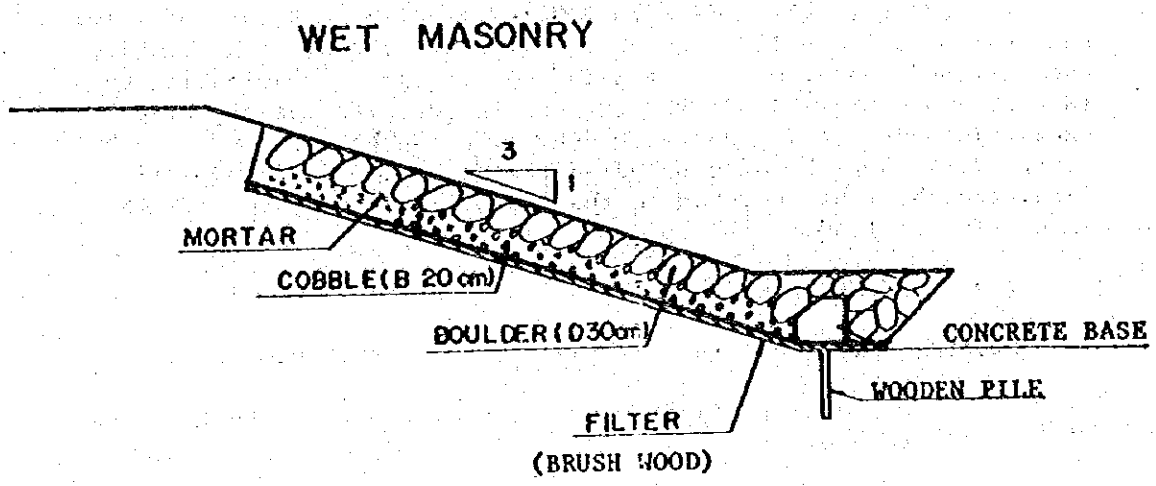
(4) Groyne work

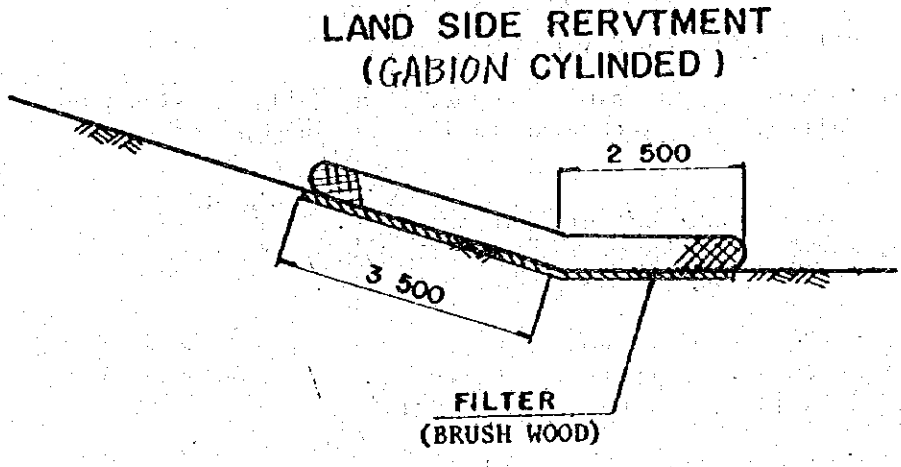
The following shows two types of the groyne work.

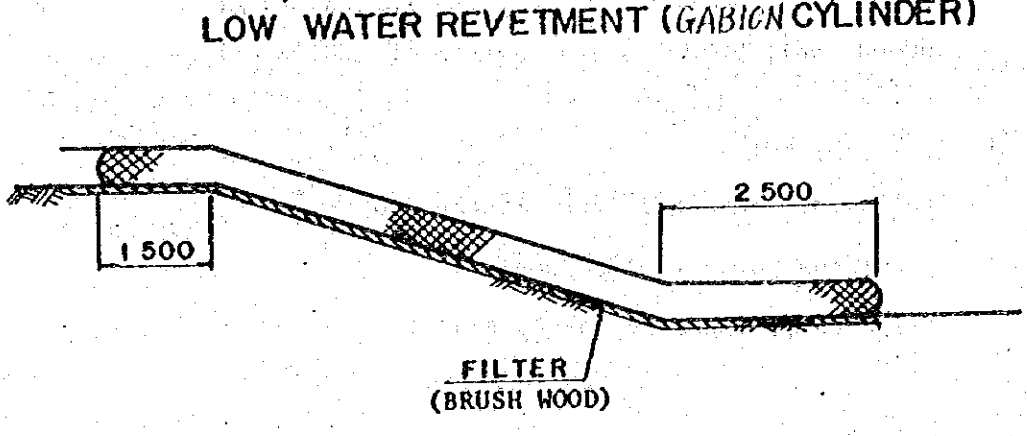
Skeleton Works (Vally Section)

Pile Levee (Sand Arresting Basin)

FIGURE III-49 TYPE OF REVETMENT



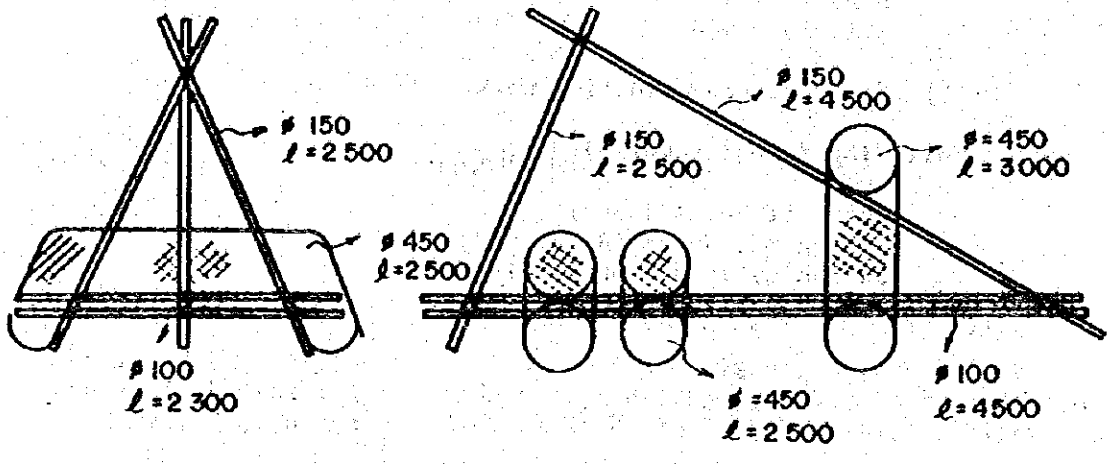




1) Skeleton works (Groyne Type A)

Fabrication of skeleton and setting of Boulder are to be carried out by manual labor at the construction site.

FIGURE III-50 GROYNE (TYPE A)



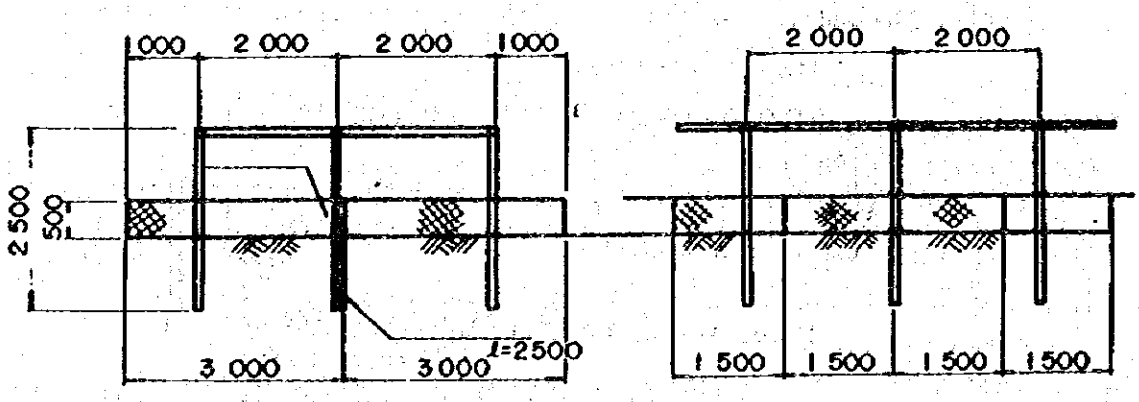
2) Pile groyne(Groyne Type B)

Gabion mat, length 3.0m x width 1.5m x thickness 0.5m, is the foundation of pile groyne. Since the length of piles are only 2.5 m, they are driven by mannual labor.

In fabrication of gabion mats, just like gabion cylinders, wire mats are made in factories, and setting of Boulder and sharpening of piles are carried out at the construction site.

FIGURE III-51 GROYNE (TYPE B)

(SECTION) (SIDE VIEW)



(5) Ground-sel (Consolidation Work)

Type and location of the consolidation works are as shown below.

Concrete Consolidation Works (Location: 2)

STA. 19 + 600
STA. 20 + 900

Wet Mortar Masonry Consolidation Works (Location: 7)

STA. 26 + 400
STA. 25 + 700
STA. 19 + 300
STA. 18 + 300 (Location: 2)
STA. 16 + 150
STA. 15 + 900

1) Concrete consolidation works

The following is major work items.

Concrete Works (Body)
Gabion Mat Works (River-bed)
Gabion Cylinder Works (Wing)
River-bed Excavation

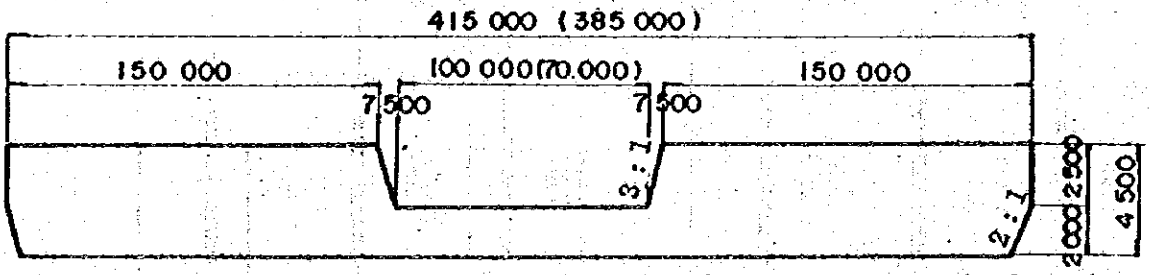
Since details are given elsewhere in the foregoing with regard to execution of works of gabion mats, gabion cylinders and river-bed excavation, only execution of concrete works is taken up herein.

According to the field reconnaissance, no surface water was observed in dry months, so diversion works are not considered necessary. Upon completion of river-bed excavation works, concrete placement works will take place.

Aggregate for concrete will be purchased. Mixing will be done by means of mixers, capacity 0.2 cu.m/batch each. Transportation of concrete will be manual. Concrete placement will be started first at opening taking drainage into consideration, and for portions below ground-water level, underwater concreting is designated because of anticipated difficulties in dewatering from the results obtained from the soil tests of the river-bed materials.

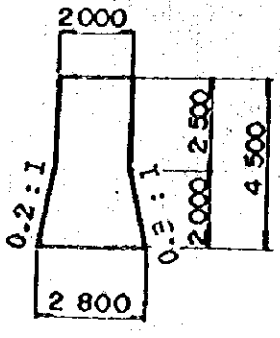
FIGURE III-52 Concrete Consolidation Works Standard Dmensions

(Ground-sel Type B)



Note: Inside bracket; upstream end of sand arresting basin

Outside bracket; downstream end of sand arresting basin

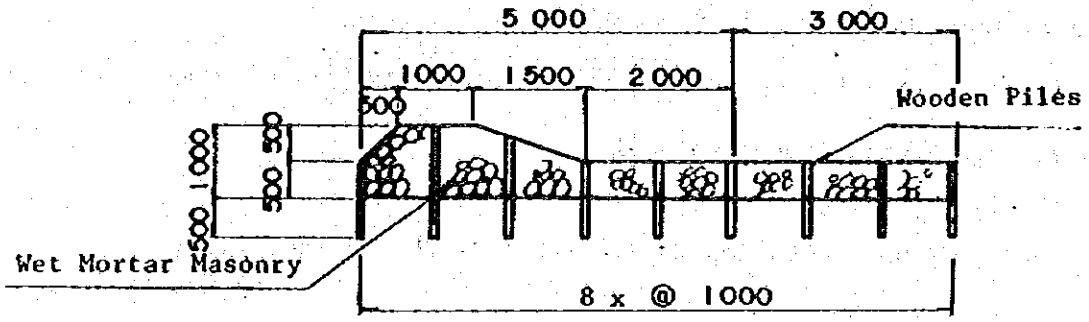


2) Wet moratar masonry consolidation works

The following is major work items.

Grading Works
Piling Works
Hurdle Frame Works
Boulder Setting Works
Mortar Works

FIGURE Ⅲ-53 GROUNDSEL (TYPE A)



Construction procedure

The following is a description of the construction procedure in the order of work sequence.

(1) River-bed excavation and grading

Land excavation, 0.5 meter in depth, and grading are carried out by 21-ton bulldozers, and loading and hauling are carried out by 1.2-cu.m. shovel-dozer and 8-ton dump trucks.

(2) Piling works

Piles come in two sizes, one is 1.0 m in length and 150 mm dia., and the other 1.5 m and 150 mm. Penetration is only 0.5 m, and this makes manual drive of the piles practical. Piles are sharpened on the job site.

(3) Hurdle frame works

Hurdle frame works mean either fitting of cross beam logs on the boulder with mortar, or split bamboo coverings on the boulder. In either case, the work is to be executed by manual labor after the main piles are driven home.

(4) Boulder setting

After completion of hurdle frame works, set boulder in the framework, from the temporary storage near the construction site, by manual labor by the aid of straw baskets.

(5) Motar works

In the boulder with mortar portion, in parallel with the boulder setting mortar is also placed at a list of 0.5 meter. Mortar is mixed by a portable mixer, capacity 0.2 cu.m. For transportation; wheelbarrows are used.

4-4 Additional Work

Kinds and location of the additional works are shown below.

Drainage Sluice (Location: 3)

STA. 1 + 856

2.0m x 2.0m Box Culverts, 2-pc., L = 32.0m

STA: 1 + 900

2.0m x 2.0m Box Culverts, 3-pc., L = 32.0m

STA. 7 + 470

1,650mm I.D. Hume Pipe, L = 9.720m

Retaining Wall

Mancation Bridge, direct downstream area
Extension: L = 320m

(1) Drainage Sluice

Sluice shall be embeded prior to construction work of levee. The following is description of the work procedure in sequential order.

1) Excavation and grading

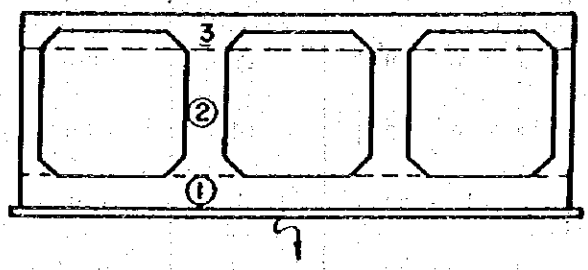
A 21-ton bulldozer will be used for excavation and grading. Surplus soil from excavation will be loaded onto 8-ton dump trucks by 1.2 cu.m. shovel-dozers. The dump truck will haul the excavated soil to the stock yard.

2) Concrete Pile Driving (0.4m x 0.4m x 24.0m)

For pile driving, a diesel pile hammar with 2-ton raw will be used. Since the length of the pile is long, L = 24.0 m., piles will be spliced.

3) Concrete work

Since concrete mixing is carried out by a 0.2 cu.m/batch mixer, concrete will be placed on top of the lean concrete layer, in three stages, marked (1), (2) and (3) as shown in the section drawing below.



4) Embankment of levee

After concrete placement and curing, embankment of the levee will follow.

With regard to the embankment of the levee, exactly the same procedure as detailed in "Embankment" will be followed. To prevent leakage, all the adjoining portions of the sluice and levee shall be filled up with clayey soil.

5) Fitting revetment works

After completion of sluice embedment, the fitting revetment of the inlet and outlet will be carried out.

(ii) Retaining wall work

Retaining walls are constructed near the bottlenecked left and right branches of the " Y" bifurcation of the Pasig-Potrero River where two bridges on the Porac-Angeles Highway are spanning near the village of Mancation. In mixing concrete, a portable mixer, 0.2 cu.m./batch, will be used, and the placement will be carried out with a lift of 1.0 meter each.

4-5 List of construction machine

TABLE III-23 LIST OF MAIN MACHINE

name of machine	specification	number	remark
Bulldozer	21 t class	27	excavation, compaction
Dozer shovel	1.2 m^3 class	19	loading
Back hoe	1.2 m^3 class	14	excavation (in Water)
ibrating Roller	6.0 t class	3	self propelled
"	0.6 t class	7	hand guid
Dump truck	8.0 t class	17	
Concrete Mixer	0.2 m^3 class	5	portable mixer
Diesel pile hammer	ram weight 2 t	1	
Crowler crane	40.0 t class	1	
Vibrator	stick type	8	

4.6 Summary of Estimated Quantity

Estimated construction quantity in the river improvement stretch and the sand arresting basin is summarized in TABLE III-24-1. The annual construction quantity is given in TABLE III-24-2.

TABLE III-24-1 Summary of Estimated Quantity

WORKS	ITEM		UNIT	QUANTITY	REMARK
Embanking			m^3	669,000	
Excavation			"	4,207,000	
Revetment		Wet masonry	m^2	160,000	total length(m) 30,000
		Gabion	m^3	33,000	
Groundsel	Wet masonry	Log	"	400	total length(m) 14,400
		Boulder	"	8,100	
		Mortar	"	2,400	
		Excavation	"	9,500	
		Reclamation	"	1,700	
		Suplus sand	"	7,800	
	Concrete	Concrete	m^3	6,900	total length(m) 800
		Form	m^2	6,400	
		Gabion	"	3,100	
		Excavation	"	13,600	
		Reclamation	"	4,900	
		Suplus sand	"	8,700	

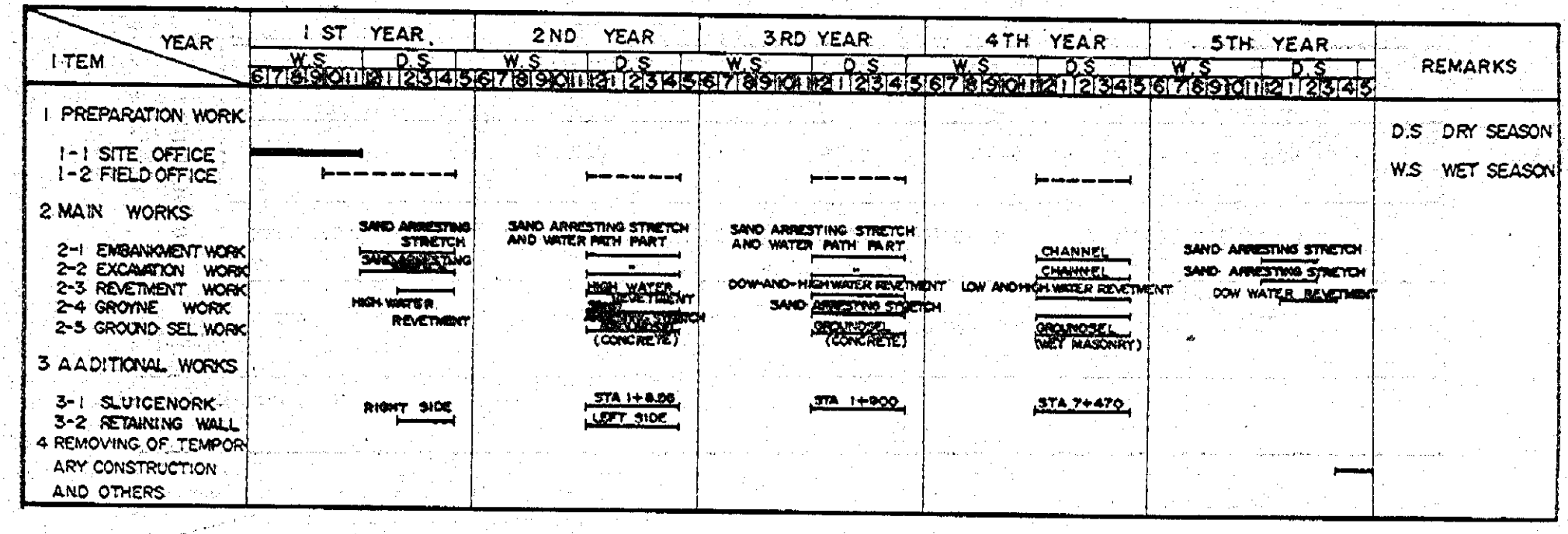
WORK	ITEM		UNIT	QUANTITY	REMARK
Groyne	Skelton	Log	m^3	200	total length(m) 18,500
		Gabion	"	400	
	Pile groyne	Log	"	800	
		Gabion	"	27,000	
	Gabion cylinder	Gabion	"	700	
Retaining wall	Gravity type	Concrete	"	2,800	total length(m) 300
		Form	m^2	3,400	
		Excavation	m^3	2,200	
		Reclamation	"	1,100	
		Suplus sand	"	2,200	
Drainage sluice		Concrete	m^3	100	total 3 p.s.
		Form	m^2	1,800	
		Concrete pile	m	3,700	
		Hume pipe	"	10	
		Gabion	m^3	700	

TABLE III-24-2 CONSTRUCTION QUANTITY YEARLY

Items \ Year		Total	1st year	2nd year	3rd year	4th year	5th year	Remarks
Site, field office								
MAIN WORKS	Embankment	m^3 700,000	60,000	190,000	210,000	190,000	50,000	
	Excavation	m^3 4,210,000	730,000	980,000	1,000,000	930,000	570,000	
	Revetment	m 30,000	2,300	4,000	7,800	8,500	7,400	
	Groyne	m 18,500		6,500	7,000	5,000		
	Ground Sel	m 1,440 800	250 600	550 200	640			
ADDITIONAL WORKS	Drainage sluice	3 point		No. 1	No. 2	No. 3		
	Retaining wall	m 350	70,000	80,000				

CONSTRUCTION SCHEDULE

TABLE III-25



4.8. Cost Estimate

1. Project Cost

The project cost is estimated in the following terms:

i) Unit costs in May of 1978 are regarded as a criterion for the estimation.

ii) Costs for machines, steel products and engineering services are included in the foreign currency portion. Other materials and labour are prepared in the local currency.

iii) Construction works for this project are done by the local contractor in accordance with the contract.

iv) Physical contingency is equivalent to 15% of the total construction cost excluding engineering cost, and price contingency is not included in the cost estimate.

v) Cost for engineering services is equivalent to 12% of the total construction cost.

vi) The exchange rate in conversion from Peso to US Dollar is ₱7.4 = US$1.00.

Details of the cost estimate and annual construction costs are given in TABLE III-26-1 and TABLE III-26-2 respectively.

TABLE III-26-1 Project Cost (1)

Unit: $x10^3$ ₱

	Unit	Quantity	F.C.	L.C.	Amount
1. Preparation Works					
Site & Field Office	Ls	1	-	1,000	1,000
2. Main Works					
Embankment	m^3	700,000	3,400	4,300	7,700
Excavation	m^3	4,200,000	10,730	18,700	29,430
Revetment	Ls	1	480	19,270	19,750
Groyne	Ls	1	-	5,380	5,380
Groundsel	Ls	1	220	5,190	5,410
3. Additional Works					
Drainage Sluice	Ls	1	70	1,340	1,410
Retaining Wall	Ls	1	40	1,120	1,160
4. Administration Expenses	Ls	1	-	5,710	5,710
5. Contingency	Ls	1	2,200	9,320	11,520
6. Engineering Service	Ls	1	4,590	4,640	9,230
Grand Total			21,750	75,970	97,720

TABLE III-26-2 Annual Disbursement of the Project Cost (2)

Unit: $\times 10^3$ ₱

Item		Year / Cost	1st	2nd	3rd	4th	5th
Prep. Wks - Site & Field Office		-	-	-	-	-	
		1,000	670	220	70	40	
		1,000	670	220	70	40	
Main Works	Embankment	3,400	480	850	960	810	300
		4,300	620	1,070	1,200	1,030	380
		7,700	1,100	1,920	2,160	1,840	680
	Excavation	10,730	1,850	2,520	2,550	2,370	1,440
		18,700	3,240	4,330	4,430	4,140	2,560
		29,430	5,090	6,850	6,986	6,510	4,000
	Revetment	480	40	65	125	135	115
		19,270	1,480	2,550	5,070	5,500	4,670
		19,750	1,520	2,615	5,195	5,635	4,785
	Groyne	-		-	-	-	
		5,380		1,940	1,980	1,460	
		5,380		1,940	1,980	1,460	
	Ground-sel	220		120	75	25	
		5,190		2,880	1,800	510	
		5,410		3,000	1,875	535	
Additional Works	Drainage Sluice	70		35	30	5	
		1,340		640	570	130	
		1,410		675	600	135	
	Retaining Wall	40	20	20			
		1,120	530	590			
		1,160	550	610			
Administration Expenses		-	-	-	-	-	-
		5,710	760	1,410	1,510	1,310	720
		5,710	760	1,410	1,510	1,310	720
Contingency		2,200	280	550	580	500	290
		9,340	1,170	2,340	2,470	2,120	1,240
		11,540	1,450	2,890	3,050	2,620	1,530
Engineering Service		4,590	990	900	900	900	900
		4,640	590	1,160	1,220	1,050	620
		9,230	1,580	2,070	2,130	1,960	1,530
Grand Total		21,730	3,660	5,060	5,220	4,745	3,045
		75,990	9,060	19,130	20,320	17,290	10,180
		97,720	12,720	24,190	25,540	22,035	13,235

Upper : Foreign currency portion
Middle: Local currency portion
Down : Total

2. Operation and Maintenance Cost

Costs for operation and maintenance in the construction period include; (1) five thousand pesos (₱5,000) for cross and profile leveling and water stage observation, (2) seventy thousand pesos (₱70,000) for operation and maintenance of river structures, (3) fifteen thousand pesos (₱15,000) for excavation (30,000 m^3/yr.) in a stretch of 3 km from Bacolor to the estuary.

After the completion of works, annual operation and maintenance cost is estimated to be one hundred and ninety-five thousand (₱195,000) for the above-mentioned costs (1), (2) and (3) and excavation (274,000 m^3/yr.) in the sand arresting basin in the upstream of Mancatian bridge.

Details of operation and maintenance costs are given in TABLE III-27.

TABLE III-27 Annual Disbursement of the Operation and Maintenance Cost

Unit: x10^3 ₱

Year	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th
Maintenance of Works	5	5	5	5	5	75	75	75	75	75	75	75	75	75	75	75
Excavation	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	120
Total	20	20	20	20	20	90	90	90	90	90	90	90	90	90	90	195

3. Economic Cost

Economic cost is estimated to be the foreign currency in the Project Cost excluding tax. Tax levied on articles is mentioned below.

a) Steel Bar and Steel Pipe 50%

b) Construction Machines 40%

Details of economic cost are presented in TABLE III-28-1, III-28-2.

TABLE III-28-1 Economical Cost

Unit: $x10^3$ ₱

	Unit	Quantity	F.C.	L.C.	Amount
1. Preparation Works					
Site & Field Office	Ls		-	1,000	1,000
2. Main Works					
Embankment	m^3	700,000	2,050	4,300	6,350
Excavation	m^3	4,200,000	6,440	18,700	25,140
Revetment	Ls		290	19,270	19,560
Groyne	Ls		-	5,380	5,380
Groundsel	Ls		140	5,190	5,330
3. Additional Works					
Drainage Sluice	Ls		45	1,340	1,385
Retaining Wall	Ls		25	1,120	1,145
4. Administration Expenses	Ls		-	5,710	5,710
5. Contingency	Ls		1,340	9,340	10,680
6. Engineering Service	Ls		4,590	4,640	9,230
Grand Total			14,920	75,990	90,910

TABLE III-28-2 Annual Disbursement of the Economic Cost

Unit: $x10^3$ ₱

Item		Year	Cost	1st	2nd	3rd	4th	5th
Prep. Wks - Site & Field Office			-	-	-	-	-	
			1,000	670	220	70	40	
			1,000	670	220	70	40	
Main Works	Embankment		2,050	290	510	580	490	80
			4,300	620	1,070	1,200	1,030	380
			6,350	910	1,580	1,780	1,520	560
	Excavation		6,440	1,110	1,510	1,530	1,420	870
			18,700	3,240	4,330	4,430	4,140	2,560
			25,140	4,350	5,840	5,960	5,560	3,430
	Revetment		290	25	40	75	80	70
			19,270	1,480	2,550	5,070	5,500	4,670
			19,560	1,505	2,590	5,145	5,580	4,740
	Groyne		-		-	-	-	
			5,380		1,940	1,980	1,460	
			5,380		1,940	1,980	1,460	
	Ground-sel		140		75	50	15	
			5,190		2,880	1,800	510	
			5,330		2,955	1,850	525	
Additional Works	Drainage Sluice		45		20	20	5	
			1,340		640	570	130	
			1,385		660	590	135	
	Retaining Wall		25	10	15			
			1,120	530	590			
			1,145	540	605			
Administration Expenses			-	-	-	-	-	-
			5,710	760	1,410	1,510	1,310	720
			5,710	760	1,410	1,510	1,310	720
Contingency			1,340	170	335	350	305	180
			9,340	1,170	2,340	2,470	2,120	1,240
			10,680	1,340	2,675	2,820	2,425	1,420
Engineering Service			4,590	990	900	900	900	900
			4,640	590	1,160	1,220	1,050	620
			9,230	1,580	2,070	2,130	1,960	1,530
Grand Total			14,920	2,595	3,405	3,505	3,215	2,200
			75,990	9,060	19,130	20,320	17,290	10,190
			90,910	11,655	22,535	23,825	20,505	12,390

Upper : Foreign currency portion
Middle: Local currency portion
Down : Total

SURVEY

I. SURVEY

This report summarizes the results of surveying made from December 12, 1977 to March 31, 1978 for the Pasig-Potrero Flood Control and Sabo Project in cooperation with the local counterparts.

Survey work required for sabo and river improvement plan had been made on the following items.

1. Setting of datum point (setting of distance-mark)
2. Longitudinal survey (38,176 m)
3. Cross-sectional survey (39,810 m)
4. Detail survey in the vicinity of the important structure site (217,040 m^2)
5. Zero elevation survey

1. Setting of Datum Point

A starting point, (STA.) 0+000 m is set at the confluence of the Gua-Gua River and the Pasig-Potrero River. Distance marks are set up every 200 m along the tops of both side levees or on the rigid ground near the riparian. And concrete distance-marks are set every 1 km.

Prior to measurement of elevation, B.M. PARC 6 (Cabetican, Bocolor) with an elevation of 4.414 m and B.M. PA.No.41 (Gua-Gua) with an elevation of 2.388 m were assured. In this survey, PARC 5 is considered as a starting point 0+000 m and measurement of elevation was made toward the up-streams of the Pasig-Potrero, Timbu and Yangca Rivers. Elevation of each B.M. is given in TABLE I-1.

To check accuracy of the survey data, elevation of the Mancatian Bridge is measured from both B.M. PARC 29 (Porac Bridge located in Porac) and PARC 6 (the starting point).

2. Longitudinal Survey

To prepare a longitudinal section, elevation of distance marks on the both-side levees, ground level, levee top elevation and the height of the existing structures were measured.

3. Cross-sectional Survey

To prepare a cross-section, elevation of the hydrometric section was measured based on the distance-mark. Cross-sectional survey was made at a pitch of 1 km between 0+000 m and the top point in the fan-head of the Pasig-Potrero River, 400 m and/or 600 m between the fan-head and the confluence with the Timbu River, and 200 m in the up-stream of the confluence with the Timbu River and in the Timbu River and the Yangca River.

4. Detail Survey

Plane survey was carried out in the vicinity of No. 5 Dam and from No. 5 Dam to the water-fall at the estuary of the Timbu River to prepare maps with a scale of 1/300 and 1/500 respectively.

Detail survey was also carried out at the following riparian structure sites to prepare a map with a scale of 1/200.

- The right and left levees in the vicinity of 1+800 m (2 places)
- The upstream right levee in the vicinity of 13+250 m
- The upstream left levee in the vicinity of 13+200 m

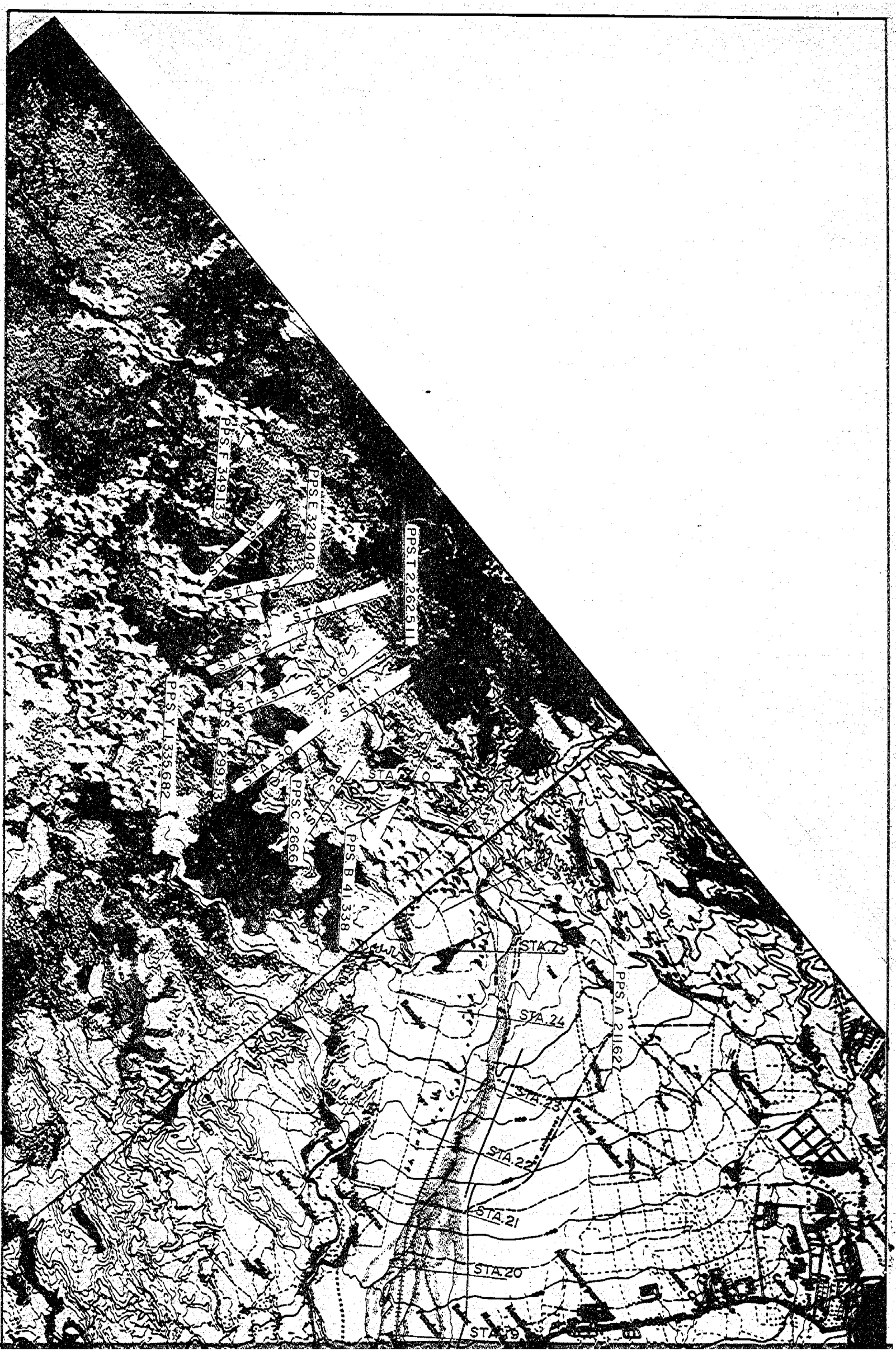
5. Other Survey

Cross-sectional and zero-elevation survey were made as follows:

i) Cross-sectional survey at the confluence of the Pasig-Potrero River and the Gua-Gua River.

ii) Cross-sectional survey at the graduated staff gauge places along the Pasig-Potrero River, Gua-Gua River and Porac River.

iii) Zero-elevation Survey at the graduated staff gauges located at Haciende Dolores, Mancatian Bridge, Bacolor, Gua-Gua and Minalin Gauge.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STA 20
STA 19

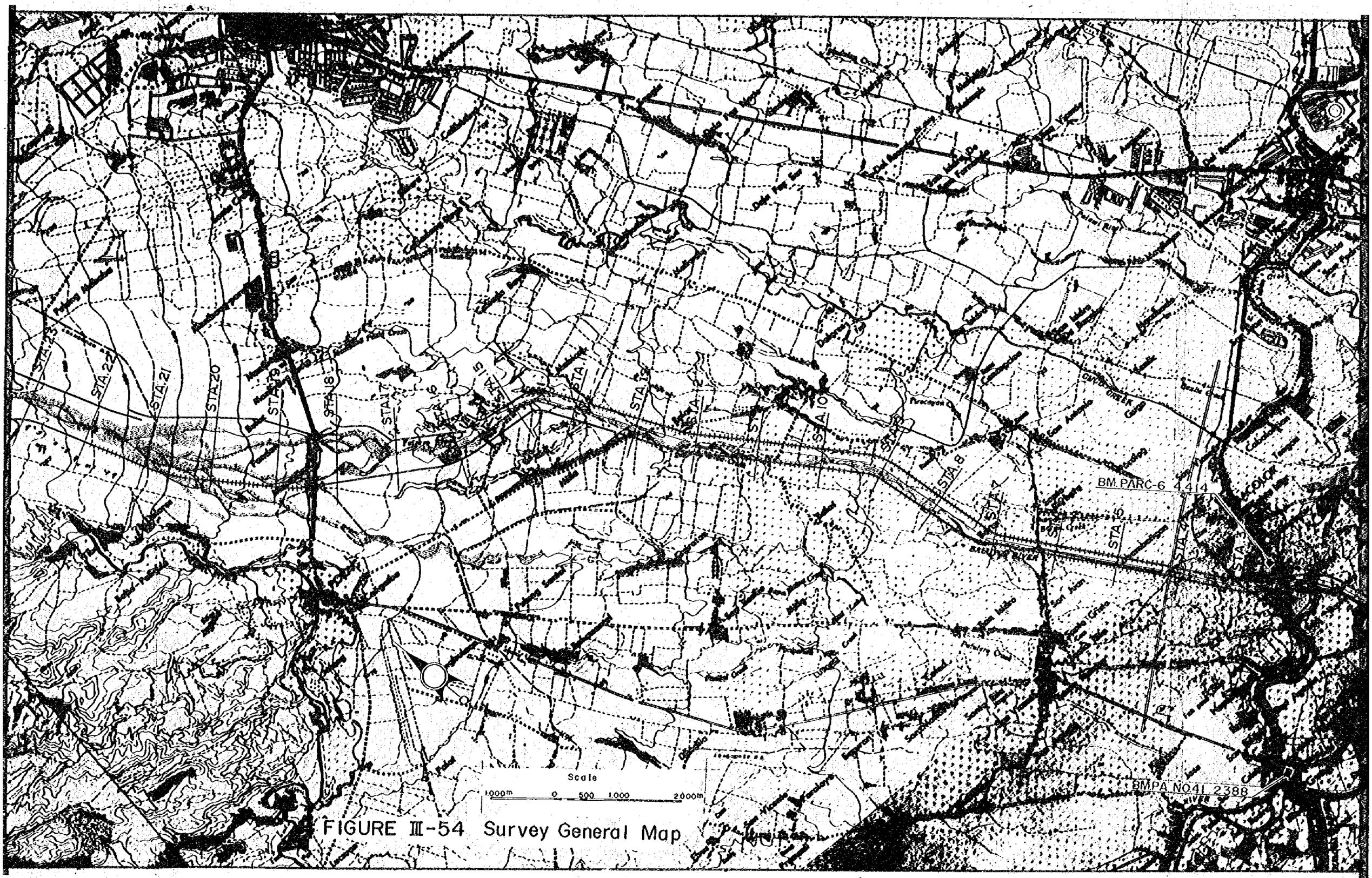

FIGURE Ⅲ-54 Survey General Map