RECONNAISSANCE REPORT ON RESERVOIR SITES IN TAIWAN

Vol. II

(South & East Taiwan)

Edited & Printed
By
Joint Commission on Rural Reconstruction
November, 1957

RECONNAISSANCE REPORT
ON
RESERVOIR SITES
IN
TAIWAN

Vol. II

(South & East Taiwan)

Edited & Printed
By
Joint Commission on Rural Reconstruction
November, 1957

CONTENTS

List of Reservoirs Arranged Alphabetically

SOUTH TAIWAN

Name of Reservoir	Series No.	Hsien	Tributary	Main Creek	Function
Ai-liao	76	Ping-tung	Ai-liao Chi	Hsia-tan-shui Chi	Multiple purpose
A-kung-tien	65	Kao-hsiung	—	A-kung-tien Chi	Irrigation, Flood Control & Water Supply
An-wa-na (Hung-hwa -yuan)	69	Kao-hsiung	Nan-tzu-hsien Chi	Hsia-tan-shui Chi	Multiple purpose
Chao-yuan-szu	71	Kao-hsiung	Chao-yuan-szu Chi	Hsia-tan-shui Chi	Irrigation
Chia-jui-chi	67	Kao-hsiung	Chia-jui-chi Chi	Hou-ching Chi	Irrigation
Chiao-li-lin	54	Tai-nan	Chiao-li-lin Chi	Tseng-wen Chi	Irrigation
Chien-shan-pi	51	Tai-nan	Kwei-chung Chi	Chi-shui Chi	Irrigation & Industrial Water Supply
Chi-nan	70	Kao-hsiung	Pei-shih Chi	Hsia-tan-shui Chi	Irrigation
Cho-kow	75	Kao-hsiung	Cho-kow Chi	Hsia-tan-shui Chi	Multiple purpose
Coral Lake (Wu-shan-tou)	53	Tai-nan	Kwan-tien Chi	Tseng-wen Chi	Irrigation
Erh-tseng-hsing (Erh-tseng-hang)	64	Kao-hsiung	—	Erh-tseng-hsing Chi	Multiple purpose
Hsia-keng	40	Chia-yi	San-tieh Chi	Pei-kang Chi	Irrigation & Flood Centrol
Keng-nei	58	Tai-nan	Sha-tzu-tien Chi	Tseng-wen Chi	Irrigation
Kwan-miao	61	Tai-nan	Hsu-hsien Chi	Yen-shui Chi	Irrigation & Flood Control
Kwei-chung	49	Tai-nan	Kwei-chung Chi	Chi-shui Chi	Irrigation & Flood Control
Kwei-tan	57	Tai-nan	Kwei-tan Chi	Tseng-wen Chi	Irrigation
Lai-she	79	Ping-tung	Lai-she Chi	Lin-pien Chi	Multiple purpose
Liang-shan	77	Ping-tung	Tung-kang Chi	Hsia-tan-shui Chi	Irrigation
Li-ly	80	Ping-tung	Li-ly Chi	Lin-pien Chi	Multiple purpose
Liu-chung	47	Tai-nan	Liu-chung Chi	Chi-shui Chi	Irrigation & Flood Control
Lu-liao	45	Chia-yi	Lu-liao Chi	Pa-chang Chi	Irrigation & Water Supply
Mei-hwa-tan	39	Chia-yi	Tao-kung-shan Chi	Pei-kang Chi	Irrigation & Scenery
Mei-nung	72	Kao-hsiung	Mei-nung Chi	Hsia-tan-shui Chi	Multiple purpose
Nan-hsi	56	Tai-nan	Ta-pu Chi	Tseng-wen Chi	Irrigation

Name of Reservoir	Series No.	Hsien	Tributary	Main Creek	Function
Nan-hu	52	Tai-nan	Nan-hu Chi	Chi-shui Chi	Irrigation
Nan-shih-hu	78	Ping-tung	Nan-shih-hu Chi	Tung-kang Chi	Irrigation
Na-pa-lin	59	Tai-nan	Na-pa-lin Chi	Yen-shui Chi	Irrigation & Flood Control
Nei-pu-tzu	43	Chia-yi	Niu-chow Chi	Po-tzu Chi	Irrigation
Pai-shui-chi	46	Tai-nan	Pai-shui Chi	Chi-shui Chi	Irrigation & Flood Control
Pao-lai	73	Kao-hsiung	Lao-nung Chi	Hsia-tan-shui Chi	Power
Pei-shih-lin	66	Kao-hsiung	Chung-chi Chi	Hou-ching Chi	Irrigation
Shen-keng-tzu	62	Tai-nan	Shen-keng-tzu Chi	Erh-tseng-hsing Chi	Irrigation & Flood Control
Shih-lung	68	Kao-hsiung	Shih-lung Chi	Hou-ching Chi	Irrigation
Shih-tzu-tou	42	Chia-yi	Shih-tzu-tou Chi	Po-tzu Chi	Irrigation
Szu-chung-chi	81	Ping-tung	—	Szu-chung Chi	Multiple purpose
Ta-pu	55	Tai-nan & Chia-yi	Ta-pu Chi	Tseng-wen Chi	Multiple purpose
Tch-yuan-pi	50	Tai-nan	Wen-tso-pu Chi	Chi-shui Chi	Irrigation
Tien-liao	41	Chia-yi	San-tieh Chi	Pei-kang Chi	Irrigaiton
Tu-lung-wan	74	Kao-hsiung	Lao-nung Chi	Hsia-tan-shui Chi	Multiple purpose
Tung-shan	48	Tai-nan	Liu-chung Chi	Chi-shui Chi	Irrigation & Flood Control
Wu-shan-keng	63	Kao-hsiung	Unknown	Erh-tseng-hsing Chi	Irrigation & Water Supply
Yen-kwan	44	Chia-yi	Chih-lan Chi	Pa-chang Chi	Irrigation
Yen-shui	60	Tai-nan	Chieh-tung Chi	Yen-shui Chi	Irrigation & Flood Control

EAST TAIWAN

Name of Reservoir	Series No.	Hsien	Tributary	Main Creek	Function
Fu-tien	85	Hwa-lien	Fu-tien Chi	Hwa-lien Chi	Irrigation
Hsiu-ku-luan	84	Hwa-lien	—	Hsiu-ku-luanchi	Power
Kao-yuan	82	Tai-tung	—	Ma-wu-ku Chi	Power
Li-yu-chih	86	Hwa-lien	—	Natural Lake	Multiple purpose
Lung-chien	87	Hwa-lien	Mu-kua Chi	Hwa-lien Chi	Multiple purpose
San-tai	83	Hwa-lien	Pieh Chi	Hsiu-ku-luan Chi	Irrigation
Shan-chiao	88	I-lan	Pei Chi	Ta-nan-ao Chi	Power & Irrigation
Shuang-lien-pi	92	I-lan	—	Natural Pond	Power & Irrigation
Tu-chang	90	I-lan	—	I-lan-cho-shui Chi	Multiple purpose
Wu-lao-keng	89	I-lan	—	Wu-lao-keng Chi	Irrigation
Yuan-shan	91	I-lan	—	I-lan-cho-shui Chi	Multiple purpose

List of Reservoirs Arranged in Various Prefectures

Mei-hwa-tan (No. 39) and Hsia-keng (No. 40) Reservoir

(See Fig. 161-162)

General Description

The proposed Mei-hwa-tan Dam site is located at the confluence of two small tributaries of Tao-kung-shan Chi, a branch of Pei-kang Chi. The proposed dam site is very near the Park of Mei-shan Hsiang, Chia-yi Hsien. The drainage area of this proposed reservoir is about 1.41 square kilometers.

The other proposed Hsia-keng Dam site is located on the tributary of San-tieh Chi is also a branch of the Pei-kang Chi. The drainage area of this reservoir is approximately 4.38 square kilometers. The construction of these two reservoirs will meet the irrigation requirement of Ta-lin area. As a whole, 18 ha. of cultivated land, 15 houses and 1.2 kilometers of highway will be submerged if these two reservoirs are built.

Geology

The rock at the proposed Hsia-keng Dam site is Tertiary grayish green sandstone. It is coarse and soft and changes to brownish yellow color after weathering. The direction of the strike of the outcrops at both banks is N10°E with dip of 3° to 5°. Mei-hwa-tan Dam site has the same character.

Hydrology

a. Rainfall

Based upon the available rainfall records at Chang-nao-liao Station (1914 - 1939), the annual rainfall is about 2,618 mm and the maximum daily rainfall is about 709 mm.

b. Stream flow

No record is available. As estimated by emperical formula, the maximum discharge is 15.23 cms at Mei-hwa-tan Dam site, and 43.80 cms at Hsi-keng Dam site.

Engineering Features

	Mei-hwa-tan Reservoir	Hsia-keng Reservoir
1. Dams		
Type	Earth dam	Earth dam
Dam crest elevation	135.00 meters	155.00 meters
River bed elevation	115.00 meters	130.00 meters
Height of dam	20.00 meters	25.00 meters
Top length	150.00 meters	240.00 meters
Earthwork volume	76,000 M^3	245,000 M^3
2. Reservoir		
Watershed area	1.41 km^2	4.38 km^2
Maximum water elevation	133.00 M	153.00 M
Total storage capacity	920,000 M^3	2,000,000 M^3
Effective storage capacity	920,000 M^3	1,812,500 M^3
3. Spillway		
Length	14.00 M	
Head	1.00 M	

Benefits

As proposed, a tunnel may be built to join these two reservoirs. The water will be enough for the irrigation of 2,000 hectares in Ta-lin and Ta-pu-mei region, which can possibly be irrigated also by Tou-liu Irrigation System if it is extended. However, due to the fact that the water supply of Tou-liu System is already not sufficient for the area irrigated now, these two projects are still worthy of consideration.

Transportation Facilities and Construction Materials

The dam sites are all about 100 meters away from the existing highways. Materials for earth dam construction are available in nearby regions.

Tien-liao Reservoir (No. 41)
(See Fig. 163-171)

This proposed reservoir is on San-tieh Chi, a branch of the Pei-kang Chi. The dam site is suggested at Tien-liao, Min-hsiung, Chia-yi. The irrigated area is situated in Hu-wei-liao, Hao-shou, Min-hsiung, Ching-pu, etc. totalling 1,545 ha.

In 1949, the Tai-nan Hsien Government undertook a topographic survey, for which 1:2,500 maps for the reservoir area and 1:500 maps for the dam site are available. Soil samples were also tested. In the following year, a plan entitled "Hao-shou Canal Supplementary Irrigation Project" was presented to the PWCB. The Hao-shou canal is an existing canal supplied from the San-tieh Chi. The area irrigated consists of 1,133 ha. of single crop and 278 ha. of double crop. The proposed project was intended to bring supplementary supply to the 1,411 ha. and, in addition, to the 134 ha. of dry farming land at Lun-tzu-ting.

The catchment area above the proposed dam site is 23.31 sq. km. The area to be irrigated lying 20 - 44 m. above the sea level is on a slope of 1 in 400.

The rock outcrop at the dam site is clayey sandstone, compactly jointed, and grayish when dry. When soaked in water, it looks dark green and can be scratched into fine powder. The dip is 10° - 15° with a strike of $N5^{\circ}E$. There will be no trouble of percolation for an earth dam.

Hydrologic Data:

In the Ching-shui basin, there is a rain gauging station at Min-hsiung established by the Chia-nan Hydraulic Association. Records are available for the period 1935 - 1952.

There were no actual flow records above the dam site. Records for 1940 - 1947 are available at Yeh-tzu-liao, about 3 km. downstream from the dam site.

Flow Records at Yeh-tzu-liao (in cms day)

	1940	1941	1942	1943	1944	1947	1948#
Jan.	-	12.02	5.08	4.23	5.65	2.15	-
Feb.	-	15.12	3.80	5.75	1.21	1.06	-
Mar.	-	46.82	1.39	6.09	1.68	1.00	-
Apr.	-	62.17	1.28	5.05	2.64	-	-
May	22.44	34.48	5.01	4.53	23.09	-	-
June	47.58	132.65	20.02	8.61	133.94	172.18	-
July	111.02	148.00	63.66	51.32	91.34	-	-
Aug.	66.83	62.76	91.56	56.28	125.45	92.25	-
Sept.	48.73	72.86	47.38	11.34	49.34	-	-
Oct.	23.27	18.60	32.52	2.79	2.79	17.11	-
Nov.	12.54	7.00	4.91	1.42	2.91	10.29	-
Dec.	9.44	9.91	3.67	1.60	5.31	11.89	-

On 1948, only river staging records are available. Yeh-tzu-liao station has a catchment area of 27.88 sq. km.

Flood Estimate: (By use of rational formula)

$Q = 0.2778\ frA$

$f = 0.78$

$A = 23.31$ sq. km.

$L = 12.5$ km.

$H = 1.11$ km.

$r_o = 370/24 = 15.42$ mm/hr.

$r = r_o(\frac{24}{T})^{2/3} = 15.42 \times (\frac{24}{T})^{2/3}$

$W = 72(\frac{H}{L})^{0.6} = 72(\frac{1.11}{12.5})^{0.6} = 16.85$

$T = \frac{L}{W} = \frac{12.5}{16.85} = 0.743 \qquad r = 15.42\ (\frac{24}{0.743})^{2/3} = 157.4$

$\therefore$ Qmax. $= 0.2778 \times 0.78 \times 157.4 \times 23.31 = 800$ cms.

Reservoir Planning:

Elev., top of dam	85.00 m.
Elev., Base of dam	63.50 m.
Height of dam	21.5 m.
Length of dam	280.00 m.
Water surface elev. (Reservoir full)	80.00 m.
Max. flood water elev.	83.00 m.
Total storage capacity	2,340,000 m^3
Dead storage (Below elev. 68 m)	85,000 m^3
Earth dam volume	158,000 m^3
Max. spillway capacity	700 cms
Length of spillway	60 m.

Other information:

The annual increase of production from the benefited area will include about 1,350 tons of paddy rice, and 6,800 tons of sweet potato. The area which will be submerged by the proposed reservoir includes 10 ha. of dry farming land, 7 ha. of paddy field, and 13 ha. of forest and weeds.

Clayey material is available near Tien-liao. A highway about 2 km long is to be built from the dam site to Yeh-tzu-liao, which already is connected by an existing highway with Min-hsiung.

This reservoir, according to the PWCB's 1949-1950 estimate, will require NT$4,000,000. If the Shih-tzu-tou Reservoir is to be built, the Tien-liao Reservoir will not be needed, since the irrigation area of the latter reservoir is covered in the former one.

Shih-tzu-tou Reservoir (No. 42)
(See Fig. 172 - 179)

A preliminary plan of this proposed reservoir was made by the PWCB in 1948. The dam site is at Shih-tzu-tou, Chu-chi Hsiang, Chia-yi Hsien. The reservoir catches 15.21 sq. km. of watershed of the creek on which the reservoir lies. In addition to the water from its own watershed, plans include diversion of water from 41.50 sq. km of Niu-chow Chi and 20.32 sq. km. of San-tieh Chi. The Niu-chow Chi water can be easily diverted by a channel through the depression at the southeast side of the reservoir, while that of the San-tieh Chi has to be diverted through a tunnel. The irrigated area, 7,500 hectares lies east of the Chia-nan Canal, south of San-tieh Chi and north of Niu-chow Chi. Of this total area, 3,297 hecatres are suffering from insufficient irrigation, while the remaining 4,203 hectares are not supplied with irrigation water.

Geology:

The geologic formation of the dam site and its vicinity is the same as that of Tien-liao site. The outcrop is brownish and greenish clayey sandstone, closely jointed, intervened by thin layers of shale. After being socked in water it can be scratched into fine powders. The Tai-nan Hsien Government made boring investigation and found that the geologic conditions are favorable.

Reservoir Planning

Elev. top of dam (earth dam)	74 m
Elev. base of dam	38 m
Height of dam	36 m
Maximum length of dam	490 m
Elev., full reservoir water surface	70 m
Elev., maximum flood water	71.60 m
Earth dam volume	1,910,000 m^3
Total storage capacity	39,410,000 m^3
Dead storage capacity (below elev. 55 m)	6,910,000 m^3
Spillway crest length (Use $Q=2.21\ LH^{3/2}$, free flow, straight ogee type, see Design Supplement No. 2, Treatise on Dams)	30 m
Spillway capacity	125 cms

Flood estimate		670 cms
Maximum Q diverted from Niu-chow Chi		10.70 cms
Maximum Q diverted from San-tieh Chi		1.80 cms
Maximum irrigation requirement		10.60 cms
Irrigation plan:	2-crop field 3,000 ha. and one-crop field (intermediate crop)	4,500 ha.
Reservoir flooded area:	Paddy field	100 ha.
	Hilly land	250 ha.
	Families	120

Discussion:

There are existing roads leading to Min-hsiung and Chia-yi Hsien. Clay for earth dam construction is also available near the dam site.

The Reconnaissance Party was deeped impressed with the serious requirement of this proposed reservoir project. In view of the large reservoir capacity, the large area to be irrigated, and the simplicity of the involved engineering work, the Party recommended early implementation of this project. While the Party was here, the fields cracked due to shortage of water. The soil, once dry and cracked, becomes hard and difficult to work.

A drawback of this site is the flooded area and homes, for which proper pre-arrangements have to be made. Another point to be investigated is that the diverted flow from the Niu-chow Chi affects or not the lower water right.

Nei-pu-tzu Reservoir (No. 43)
(See Fig. 180)

General Description

The existing Nei-pu-tzu Reservoir with a watershed area of 3 square kilometers and an effective storage of 910,000 M^3, is located 2 kilometers north-east of Lin-tzu-wei, Min-hsiung Hsiang, Chia-yi Hsien. The available water is for the irrigation of 244 hectares in Nei-pu-tzu, Chi-ti-liao and Ta-chiu-yuan districts. It was completed in 1942 under the supervision of the Chia-yi Regional Office of the Chia-nan Hydraulic Association.

This reservoir is on Niu-chow Chi, a branch of Po-tzu Chi. The slope of Niu-chow Chi is about 1/500 to 1/1,000.

Geology

The rock of the whole basin is Tertiary grayish green shaly sandstone. It is coarse, weak and soft and can easily be weathered.

The soil in the upstream is silty loam underlain with sand and gravel deposit.

Hydrology

a. Rainfall - There was a rain gaging station at Min-hsiung Working Station of Chia-yi Regional Office. Rainfall records during 1920 - 1929 are available.

b. Discharge - No record is available. The estimated maximum flood discharge is 50 C.M.S.

Engineering Features

1. Dam

Type	Earth dam
Crest elevation	61.00 meters
River bed elevation	49.00 meters
Height of dam	12.00 meters
Crest length	172.00 meters
Width	5.00 meters

2. Reservoir

Watershed area	3.00 Km^2
High water level	58.00 meters
Reservoir water area (during full)	0.21 Km^2
Total storage capacity	910,000 M^3
Effective storage capacity	910,000 M^3

3. Spillway

Length	26.2 meters
Head on crest	1.00 meter
Capacity	50.00 cms

Cost:

The total construction cost of this project was $255,000,00. of Japanese Currency.

Benefit

This project converted 50 ha. of weather depending farm into single crop paddy field and another 194 ha. into 2-year rotation irrigation field.

Yen-kwan Reservoir (No. 44)
(See Fig. 181)

General Description

The proposed dam site is located at a gorge of a small tributary of Chih-lan Chi, a branch of Pa-chang Chi. The watershed area above the dam site is about 5.01 sq. kilometers. The river bed slope near the proposed dam site is about 1 to 80. During the Japanese Occupation, it was proposed to build an earth dam at the gorge section to store water for the expansion of irrigation in the downstream area. About 8 ha. of land will be submerged if this reservoir is built.

Geology

The outcrops at the right bank are grayish green sandstones. It is soft and has no clear joints between layers. At the left bank, yellowish brown sandstones are found which are coarse and soft. The left bank apparently has a better rock formation than the right bank. The strike of the outcrops at both banks follows a direction of N15°E with 20° dip toward downstream.

Hydrology

a. Rainfall - Rainfall records at the following stations can be used for reference:

Station	Observation Period	Years of Record Referred by this Report	Max. Daily Rainfall in mm.	Annual Mean Rainfall in mm.
Chia-yi	Jan. 1901 up to now	52	500.20	1998.60
Shan-tzu-ting	April 1915 up to now	38	409.50	2138.90
Nan-ching	April 1914 up to now	39	555.00	1878.50
Yen-shui	Dec. 1903 up to now	50	370.30	1478.40
Fen-chi-hu	Aug. 1911 up to now	8	1033.00	4382.00

b. Discharge - A river stage gauge was set up at Cho-kow upstream of Pa-chang Chi during May, 1940 to Jan., 1945. There was another stage gauge at Shui-shang of which the observation records during Jan., 1914 to Dec., 1946 are still available. At the proposed dam site, it is estimated by using emperical formula that the max. flood discharge is 50 C.M.S.

Engineering Features

1. Dam

Type	Earth dam
Elevation of crest	145 meters
Elevation of river bed	128 meters
Height	17 meters
Length at crest	162 meters
Total volume of earthwork	95,700 M^3

2. Reservoir

Watershed area	5.01 Km^2
High water level	143 meters
Total storage capacity	2,500,000 M^3
Effective storage capacity	2,500,000 M^3

3. Spillway

Length	10 meters
Head on crest	1 meter

Benefits

This reservoir if constructed will provide irrigation for 200 ha. of dry land in Yen-kwan district and improve another 130 hectares of irrigated area to the east of the existing Chia-nan Irrigation Canal.

Transportation Facilities and Construction Materials

There is a highway from Chia-yi to Chung-pu. The road from Chung-pu to the proposed dam site for about 2 kilometers was also completed, but without any pavement.

Lu-liao Reservoir (No. 45)

(See Fig. 182)

General Description

Lu-liao Reservoir for the water supply of the Nan-ching Sugar Factory was built in 1937 to 1939. The dam is located 12 kilometers southwest of Nan-ching on the confluence of Lu-liao Chi and Tou-chien Chi, two tributaries of Pa-chang Chi.

Hydrology

Rainfall: Mean annual rainfall (1927 - 1936) = 2121.60 mm

Minimum annual rainfall = 1573.80 mm

Engineering Features

1. Dam

Type	Earth dam
Crest elevation	76.00 meters
Height of dam	30.00 meters
Crest length	270.40 meters
Top width	6.50 meters
Volume of earthwork	168,700 M^3
Core wall	R. C. Core Wall
Top width of core wall	0.5 meter
Bottom width of core wall	1 - 1.4 meters
Length of core wall	280.40 meters
Top elevation of core wall	74 meters

2. Reservoir

Watershed area	7.49 sq. km.
Reservoir area	0.55 sq. km.
High water level	72.50 meters
Total storage capacity	3,783,000 M^3

3. Spillway

Type	Ogee Type
Capacity	135.40 cms
Length	30.00 meters
Head	1.90 meters

Pai-shui-chi Reservoirs (No. 46)

(See Fig. 183 - 185)

General Description

There are two possible dam sites on Pai-shui Chi. The proposed dam site (A) is located on a small tributary of Pai-shui Chi north west of Pai-shui-chi Tsun, Pai-ho Chen, Tainan Hsien. This small tributary meanders in hilly region with a slope of about 1/150. The site is located in a gorage about 300 meters upstream from the confluence. The watershed area above this site is 3.56 square kilometers. As planned by the Japanese, the water of Tou-chien Chi, north of the catchment area and Pai-shui Chi south of the catchment area can be diverted into this reservoir as supplementary supply. The following maps prepared by the Japanese are available and kept by Tai-nan Hsien Government.

1. Topographical maps of the dam site, Scale 1:500
2. Topographical maps of the reservoir site, Scale 1:2,500
3. Geological maps of dam site and its adjacent region, Scale 1:5,000

The proposed dam site (B) is located southwest of the site (A) by the side of an existing bridge with a water-shed area of 25.85 sq. kms This site was included by Japanese engineer Yiata in his report "Reservoirs of Chi-shui Chi System". It was aimed for irrigation and flood control. No cultivated land will be submerged at site (A). Five ha. of cultivated land, 12 ha. of dry land, 6 houses, 2 km. of railroad and one bridge will be submerged if site (B) is adopted.

Geology

The rock at dam site (A) is brown sandstone and is coarse and weak. It can be easily weathered and breaks into big pieces. The strike of the outcrops at both banks takes a N-S direction with 28° dip.

The rock at site B in the upper part of Pai-shui Chi tributary is Tertiary sandstone with alternate layers of sandstone and shale and is hard and dense. In the midstream, it is grayish green sandy shale inter-laminated with layers of sand stone and shale. The rock at the proposed dam site B is Tertiary sandstone (Chien-ta-pu Strata) and is coarse and soft. The strike of the outcrops at both banks have a direction of $N40^{\circ}E$ with 30° - 40° dips.

Hydrology

(a) Rainfall: Rainfall records of Chien-ta-pu Stations for 43 years (1903-1945) are available. Records of Fen-chi-hu station may be used for reference also.

(b) Discharge: a stream gauging station was established at Pai-ho during 1940-1945. The estimated discharge at site (A) is 39 cms and at site (B) is 225 cms.

Engineering Features

		Site A	Site B
1.	Dam		
	Type	Earth or rock fill	Earth or rock fill
	Dam crest elevation	112 meters	108 meters
	River bed elevation	81 meters	70 meters
	Height of dam	31 meters	38 meters
	Crest length	114 meters	340 meters
	Volume of dam	108,000 M^3	587,000 M^3
2.	Reservoir		
		Site A	Site B
	Watershed area	27.38 Km^2 Including Pai-shui Chi and Tou-chien Chi watershed areas	25.85 Km^2
	High water level	110.00 meters	
	Reservoir area	0.80 sq. km.	1.60 Km^2
	Total storage capacity	8,300,000 M^3	18,500,000 M^3
	Effective storage capacity	8,300,000 M^3	For irrigation - 11,300,000 M^3 For flood control: 7,200,000 M^3
3.	Spillway		
	Length	12 meters	
	Head on crest	1.2 meters	
	Capacity	26.00 cms	

Engineering Cost

The total engineering cost for site A was estimated at $565,000, and for site B $1,413,000, all of Japanese Currency.

Benefits

After the completion of either reservoir, besides some supplementary water supply can be provided to 2,842 ha. of irrigated land, the water will be enough to irrigate a new area of 602 ha. If the site (B) is selected, it will reduce the flood peak by 13%.

Transportation Facilities and Construction Materials

Both light track railroad and urban highway are not far from both sites. Fine and coarse aggregates and materials for earth dam are available at nearby places.

Liu-chung Reservoir (No. 47)
(See Fig. 186 - 187)

General Description

The proposed dam site is located on Liu-chung Chi, a branch of Chi-shui chi, at a distance of about 4 kms to the east of Tung-shan Hsien between Yang-tzu-keng and Tzu-tung-chi Tsun. The river here has a gorge section before entering the alluvial plain. The drainage area at the proposed dam site is 27.5 km^2 based upon the military maps with a scale 1:25,000. Some investigation work was done by the Japanese and 1:5,000 maps for the reservoir area and 1:500 maps for the proposed dam site are kept in Tai-nan Hsien Government Office.

20 hectares of dry land and 30 houses will be submerged if this reservoir is built.

Geology

The rock in the upstream of Liu-chung Chi is Tertiary dark gray shale with alternate layers of sandstone and shale. In the middle stream the rock is gray shaly sandstone and in the down-stream it is brown sandstone.

At the proposed dam site, coarse grained grayish green shaly sandstone is found. It is soft and weak without clear stratification. The direction of the strike of the outcrops at both banks is N25°E with dip of 20° - 30°. The river bed is rather flat. The geology of the plateau and the plain belongs to the Quaternary System cloven with silty loam.

Hydrology

a. Rainfall

There is no rainfall station in the catchment area. Based upon the records of Chien-ta-pu Station during 1903 - 1945, the average annual rainfall was about 2206 mm, the minimum annual rainfall was 1255.60 mm in 1942 and the maximum annual rainfall was 3285.60 mm in 1935.

b. Stream flow

A stream gauge was established at Kan-tzu-tou in May, 1940. Intermittent records during May 1940 to December 1944, November 1946 to December 1947 and November 1950 up to date are available.

c. Flood estimate

The estimated maximum flood discharge is 250 cms.

Engineering Features:

1. Dam

Type	Earth dam
Crest elevation	55 meters
River bed elevation	28 meters
Height of dam	27 meters
Crest length	855 meters
Volume of earth work	464,800 M^3

2. Reservoir

Drainage area	27.50 km^2
High water level	52.00 meters
Reservoir area	85.00 ha.
Maximum drawdown	12.00 meters
Total storage capacity	7,600,000 M^3
Dead storage capacity	1,300,000 M^3
Effective storage capacity	6,300,000 M^3

3. Spillway

Type	Morning glory type
Diameter of vertical shaft	23.00 meters
Capacity	150 C.M.S.

Benefits

1. Irrigation

This reservoir will provide sufficient amount of water to convert 1,460 ha. of dry land into paddy field.

2. Flood control

Since the proposed reservoir can catch one-fifth of the annual runoff of the drainage area, some flood damage can be prevented.

Trans ortation Facilities and Construction materials

The site can be reached by a highway. The light sugar railway is also not far from the site. Suitable earth for dam construction is also available in close-by area.

Tung-shan Reservoir (No. 48)

(See Fig. 188-189)

General Description

The proposed dam site is located on a branch of Liu-chung Chi, a branch of Chi-shui Chi, at Shan-chiao Tsun, a rural village south west of Tung-shan Hsiang, Tai-nan Hsien. Tung-shan Hsiang was called Fan-she, so was this reservoir called Fan-she Reservoir. The drainage area above the dam siteis only about 1.87 km^2. An earth dike and some canals were built about 100 years ago for irrigation. The dike was damaged and the old site can still be traced. Under the request of the local people, Tai-nan Hsien Government made a survey in 1947 and the following maps are available:

1. Topographical maps of the proposed reservoir - Scale 1:3,000
2. Topographical maps at the dam site Scale 1:500
3. Topographical maps of the area to be irrigated Scale 1:2,500

In the preliminary proposal worked out by the Hsien Government, a tunnel for diverting water from Liu-chung Chi into this proposed reservoir was mentioned. The profile of this proposed tunnel is also available.

The area to be irrigated has a slope of 1 to 200. Its elevation is 30-50 m above sea level. If this dam is built about 5 ha. of cultivated land will be submerged.

Geology

In the reservoir area, the rock is principally Tertiary grayish green shaly or brown sandstone. At the dam site, it is brown sandstone at the right bank and grayish green shaly sandstone at the left bank. The direction of the strike of the outcrops at both banks is N50° E with 65° dip toward upstream. The region to be irrigated is rather young terrace deposit covered with silty loam.

Hydrology

1. Rainfall: Reference is to be made to Liu-chung Reservoir.

2. Stream Flow: A stream gaging station was established at Pai-ho in the upstream of Liu-chung Chi in 1940. Observation was discontinued in 1944. Records for 5 years are available.

3. Flood Estimate: The flood discharge at the dam site is estimated to be 21 cms.

Engineering Features

1. Main dam

Type	Earth dam
Dam crest elevation	64.00 meters
River bed elevation	4.250 meters
Height of dam	21.50 meters
Crest length	160.00 meters
Volume of earth work	151,000 M^3

2. Reservoir

Drainage area	1.87 km^2
High water level	62 meters
Reservoir area	38.4 hectares
Maximum drawdown	12 meters
Total storage capacity	2,192,000 M^3
Dead storage capacity	77,000 M^3
Effective storage capacity	2,115,000 M^3

3. Diversion Tunnel

Length	2,000 meters

Benefits

This reservoir, if built, will provide irrigation for 1,230 ha. of dry land in Tung-shan and Ta-chuang area in the downstream of the creek.

Transportation Facilities and Construction Materials

There is a rural highway between Hsin-ying and Ta-chuang. The road between Ta-chuang and Shan-chiao is not paved. There is no road between Shan-chiao and the dam site.

The earth for dam construction is available at nearby area and sand and gravel can be collected from Liu-chung Chi about 3 km from the dam site.

Kwei-chung Reservoir (No. 49)
(See Fig. 190)

General Description

Kwei-chung, Pai-shui and Liu-chung are the three main tributaries of Chi-shui Chi. The proposed dam site is located on Kwei-chung Chi east of Shan-tzu-chiao Tsun, Liu-ying Hsiang, Tai-nan Hsien where the river flows in mountainous region just before entering the plain.

The existing Chien-shan-pi reservoir is south of this proposed site.

After the completion of the Coral Lake Reservoir, Mr. Yiata, a Japanese Engineer, made some study on Chi-shui Chi Basin and work out a proposal named "The Reservoir Projects of Chi-shui Chi System". This proposal covers the construction of storage reservoirs on the tributaries of Chi-shui Chi primarily for mitigating flood flows and secondarily for providing water for industrial use. In this proposal, no irrigation development was attempted. As mentioned in the report, the flood flow of Chi-shui Chi can be reduced from 1,300 cms down to 550 cms after the completion of the proposed reservoirs.

The following maps surveyed by the Japnese Engineers are available in the Construction Bureau of Tainan Hsien Government for reference:

1. Topographical maps of Kwei-chung Dam site Scale 1:500
2. Topographical maps of Kwei-chung Reservoir site Scale 1:5,000

The drainage area of Kwei-chung Chi above the proposed dam site is 82.25 km^2 (of which 10.6 km^2 is controlled by Chien-shan-pi Reservoir) with a slope of 1 to 300 in the proposed reservoir region.

60 farm houses, 35 hectares of cultivated land and 3 km. of rural highway will be submerged, if this reservoir is built.

Geology

The rock at the dam site is composed of grayish green shaly sandstone and is coarse and weak. It can be easily weathered and disintegrated into clay. The strike of the outcrops at both banks has a N20° E direction with dip of 74°.

Hydrology

1. Rainfall

At Chien-ta-pu, above the proposed dam site, there is a rainfall station established since December 1903. Up to date, the records for

a period of over 50 years are available. The mean annual rainfall is 2205.70 mm and the maximum daily precipitation is 425.40 mm.

2. Stream Flow

The stream gauging station at Shan-tzu-chiao close-by the dam site was established in 1940. Records from 1940 to 1944 and from 1946 to now are available.

3. Flood Estimation

As estimated by means of synthetic unit hydrograph method, the maximum discharge at the dam site of Kwei-chung Chi is 630 cms.

Engineering Features

1. Dam

Type	Earth dam
Dam crest elevation	36.00 meters
River bed elevation	13.00 meters
Height of dam	23.00 meters
Crest length	971.00 meters
Volume of dam	640,000 M^3

2. Reservoir

Drainage area	82.25 km^2
High water level	34.60 meters
Low water level	20.00 meters
Total storage capacity	26,000,000 M^3
Effective storage capacity	22,000,000 M^3

3. Spillway

Length	32.00 meters
Head on crest	1.40 meters
Capacity	300 cms

Benefits

Based upon the available runoff records for 5 years, a flow of 1.57 cms can be maintained after this reservoir is built. This amount of supplementary supply will be enough to irrigate additional

1,100 hectares in Chia-nan district at a duty of water of 700 hectares per cms. Furthermore, the reservoir can mitigate the flood peak from 630 cms down to 300 cms as estimated by the reconnaissance party.

Transportation Facilities and Construction Materials

A highway is available from Tainan to Shan-tzu-chiao Tzun. A new highway of 800 meters has to be built from Shan-tzu-chiao to the proposed dam site.

Sand and gravel at the dam site can be used for concrete work.

Teh-yuan-pi Reservoir (No. 50)
(See Fig. 191)

General Description

This project was built with JCRR's loan. The dam is located near Liu-ying on Wen-tso-pu Chi, a tributary of Chi-shui Chi. The drainage area of this reservoir is 32.1 km^2. This creek serves as a main drainage channel of the Chia-nan Canal Irrigation System.

Geology

The reservoir area is composed of deposits of Quaternary System. Yellowish clay is found as top cover. Some sand layer in black color was found during excavation of the foundation of the spillway.

Hydrology

1. Rainfall

Records from 1932 to 1953 of Liu-chia Station were adopted for design purposes.

2. Flood Flow

Within past 22 years, the maximum daily rainfall was 456 mm. However a value of 1,000 mm per day was used by this project. The designed capacity of the radial gated spillway is 532 cms and that of the emergency spillway is 168 cms.

Engineering Features

1. Dam

Type	Earth dam
Crest elevation	16.00 meters
River bed elevation	8.15 meters
Height of dam	7.85 meters
Crest length	194.00 meters
Crest width	5.00 meters
Earthwork (repair only)	7,395 cubic meters

2. Auxiliary dam

Maximum height	2.12 meters
Crest width	5.00 meters
Length	448.50 meters
Earthwork	9,181.00 cubic meters

3. Reservoir

Drainage area	26.66 Km^2 (Excluding the drainage area of two existing ponds)
High water surface elevation	14.00 meters
High water surface area	153.90 hectares
Total storage capacity	3,409,100 M^3
Effective storage capacity	3,309,100 M^3
Water surface elevation during flood	14.5 meters
Water surface area during flood	175.4 hectares
Flood storage (Elev. 14 to Elev. 14.5)	822,700 M^3
Drainage area	32.11 km^2 (including the drainage area of two existing ponds).

4. Spillway

Type	Radial gate type
Gate bottom elevation	9.30 meters
Designed capacity	532 cms
Gates	5 sets (5m x 6m) electrically operated

5. Emergency Spillway

Type	Open cut type
Length	169.00 meters
Water depth	1.50 meters
Designed capacity	168 cms
Bottom width	40 meters

Construction Cost

The total engineering cost of this project was NT$5,769,580.50

Benefits

As estimated, the total increase of production amounts to NT$5,302,080 per annum.

Communication

The project site can be reached by car from Liu-ying, Tainan Hsien.

Chien-shan-pi Reservoir (No. 51)
(See Fig. 192)

General Description

This reservoir is built on a small tributary of Kwei-chung Chi of Chi-shui Chi at the boundary of Kuo-yi-hou, Liu-ying Hsiang and Erh-chung-chi, Tung-shan Hsiang with a drainage area of 10.60 km^2. The dam has a height of 23.50 meters. The reservoir water is used by the Hsin-ying Sugar Factory, Hsin-ying Alcohol Distillery and Hsin-ying Paper Factory, and for the water supply of Hsin-ying and Yen-shui districts and for sugar cane irrigation. The original storage volume in 1938 of this reservoir was 6,950,000 M^3 and raised to 7,730,000 M^3 in 1944 through heightening the crest of the spillway by 0.91 meter. However, this storage capacity was gradually reduced by silt and the actual storage capacity was only 4,350,000 M^3 in 1951. In other words, there were 3,380,000 M^3 of silt deposit in a period of 13 years. Furthermore, owing to the fact that the outlet of the reservoir is at a very low elevation, it was frequently blocked up by the silt deposit and caused interuption to the delivery of water. For the purpose of reducing silt deposit and improving the defect of the existing outlet, a flushing tunnel was built. It has been found that the functions of this flushing tunnel are fairly good.

Above the reservoir, there are two tributaries. The drainage area of the east one is about 2.72 times that of the west one. The east tributary is 3,500 meters long with an average slope of 1 to 82.

Geology

In the drainage area, soft sandstone, clayey slate and shale of Tertiary period are found and overlaid with a layer of sedimentary deposit of the Quaternary system at a depth of 4.6 to 9.20 meters. One can easily imagine the seriousness of erosion problem in an area with such kind of geological formation.

Engineering Features

1. Dam

Type	Earth dam
Dam crest elevation	43.50 meters
River bed elevation	20.00 meters
Height of dam	23.50 meters
Dam crest length	220.00 meters

2. Reservoir

Drainage area	10.60 km^2
High water level	41.80 meters
Reservoir area	78.00 hectares
Maximum drawdown	17.6 meters
Total storage capacity (original)	7,730,000 M^3
Effective storage capacity (original)	7,397,000 M^3

3. Spillway

Length	30.30 meters
Designed overflow head	1.12 meters
Capacity	114.00 cms
Crest elevation	41.80 m

Nan-hu Reservoir (No. 52)
(See Fig. 193-194)

General Description

The proposed dam site is located on a small branch of Nan-hu Chi, a tributary of Chi-shui Chi at about 1 kilometer to the southeast of Kuo-yi Tsun, Liu-ying Hsiang, Tai-nan Hsien. The drainage area above the dam site is about 1.6 square kilometers. The annual mean rainfall in this region is about 1,800 mm.

The proposed project consists of the construction of an earth dam to store 1,000,000 M^3 of water for the irrigation of over 150 hectares in Kuo-yi area between the foot hill and Chia-nan North Main Canal.

An earth dam was built in the past, but destroyed by flood. The site of the old dam is still traceable.

Two houses and 4 hectares of land will be submerged if this dam is built.

Geology

The rock of the catchment basin is Tertiary brown sandstone. The rock of the gorge, where this dam is proposed, is essentially grayish green shaly sandstone and is coarse and weak. It turns into clay when wetted.

Hydrology

1. Rainfall

Rainfall records of Wu-shan-tou Station may be used for reference. The observation was started in 1931.

2. Stream Flow

No observation has been made.

3. Flood Estimation

The estimated maximum flood flow at the proposed dam site is 17.7 cms.

Engineering Features

1. Dam

Type	Earth dam
Dam crest elevation	44.00 meters
River bed elevation	32.00 meters
Height of dam	12.00 meters
Crest length	100.00 meters
Volume of earth work	11,600 M^3

2. Reservoir

Drainage area	1.6 km^2
High water level	42.00 meters
Reservoir area	0.22 km^2
Maximum drawdown	7.00 meters
Total storage capacity	1,000,000 M^3
Dead storage capacity	200,000 M^3
Effective storage capacity	800,000 M^3

Benefits

This reservoir will provide enough irrigation water for an area of 150 hectares.

Transportation Facilities and Construction Materials

A rural highway to the dam site is available. However it should be improved for a distance of about 1 km. Earth dam material is available in nearby area.

Coral Lake (No. 53)

(Wu-shan-tou Reservoir)
(See Fig. 195)

General Description

Coral Lake, also called Wu-shan-tou Reservoir, is the principal reservoir of Chia-nan Canal Irrigation System. The dam was built on Kwan-tien Chi, a tributary of Tseng-wen Chi, at Wu-shan-tou, Kwan-tien Hsiang, Tai-nan Hsien. The total drainage area of Kwan-tien Chi above the dam site is only 60 km^2 which is too small to meet the demand of water. For the purpose of diverting the water from Tseng-wen Chi into this reservoir, a tunnel, 3,107 km in length, was built with an intake on the right bank of Tseng-wen Chi at Wang-lai-tse.

The construction work of this system was started in 1920 and completed in 1930.

Geology

The rock in the reservoir area consists of grayish green shaly sandstone and sandstone of Tertiary system. It is coarse and weak and can be easily weathered, but it is rather impermeable.

Engineering Features

1. Intake at Tseng-wen Chi

The intake is located on the right bank of Tseng-wen Chi at Chao-hsing Tsun, Nan-hsi Hsiang, Tai-nan Hsien. It is a reinforced concrete structure with three sets of gates. There are twelve gates in each set with a maximum designed discharge of 50 cms. Gates are of verticla lift type.

2. Diversion Tunnel

The tunnel begins from the intake and ends in the reservoir with a total length of 3,107 meters. It is a horse-shoe type tunnel, 5.45 meters in height and width, with a grade 1 to 1,200. The capacity of the tunnel is also 50 cms. The arch ring and side walls were built with brick masonry and the remaining portions were built with concrete.

3. Dam

Type	Earth Dam (Semi-hydraulic filled)
Dam crest elevation	66.00 meters
Height of dam	56.00 meters

	Dam crest length	1,273.00 meters
	Top width	9.00 meters
	Base width	303.00 meters
4.	Reservoir	
	Drainage area	60.00 km^2
	Capacity	166,667,000 M^3
	Area of water surface when full	13.00 km^2
	Maximum water depth	32.00 meters
5.	Spillway	
	Length	121.20 meters
	Capacity	1,502.50 cms
6.	Intake tower	

It is located in the reservoir by the side of the dam. It is 14.85 meters in height and 6.48 meters in diameter. The inflow velocity varies from 0.303 to 0.758 meter/sec.

7. Valves

Emergency valve: Butterfly type with an inner diameter of 2.73 m.

Preliminary regulating valve: Inner diameter 1.81 meters.

Regulating valve: 4 - Eccentric balance needle valves, outer dia 1.52 meters;

2 - needle valves, outer dia 1.52 meters

Benefits

This reservoir is the principle source of water for the irrigation of 82,366 hectares of three-year-rotation area in Chia-nan Area.

Problem

The silting problem of this reservoir is quite noticeable. Information on the measurement of silt content of incoming water, and on the amount of silt deposited in the past and data of mechanical and chemical analyses made are available. Reference can be obtained from Chia-nan Hydraulic Association and will not be detailed in this report.

Chiao-li-lin Reservoir (No. 54)
(See Fig. 196-198)

General Description

The proposed dam site is located at a gorge of Chiao-li-lin Chi, about 700 meters to the west of Chiao-li-lin Tsun, Kwan-tien Hsiang, Tai-nan Hsien. Chiao-li-lin Chi is a tributary of Tseng-wen Chi with a drainage area of 5.12 km^2 above the proposed dam site.

A survey of this proposed dam site was made by the Tai-nan Hsien Government in 1941 and the following maps are available.

Topographical maps of the dam site: Scale 1 to 2,500

Topographical maps of the reservoir area: Scale 1 to 2,500

This project was proposed to irrigate 500 ha. of weather depending farm north of Tseng-wen Chi and east of Chia-nan South Main Canal at She-tzu, Kwan-tien Hsiang.

Geology

The rock at the dam site is Tertiary grayish green shaly sandstone. The quality of which is coarse and weak. The direction of the strike of the outcrops of both banks is N5°E with dip of 10°.

Hydrology

1. Rainfall

Based upon the records of Wu-shan-tou Rainfall Station which was started in 1931, the annual mean rainfall is 1,800 mm. The maximum daily rainfall is 347.30 mm.

2. Flood Estimation

The estimated maximum runoff at the proposed dam site is 123 cms.

Engineering Features

1. Dam

Type	Earth dam
Dam crest elevation	46.00 meters
River bed elevation	25.00 meters
Height of dam	21.00 meters

	Dam crest length	170.00 meters
	Volume of earthwork	101,000 M^3
2.	Reservoir	
	Drainage area	5.12 km^2
	Highwater level elevation	43.00 meters
	Water surface area when full	0.54 km^2
	Dead water level	36.50 meters
	Total storage capacity	3,000,000 M^3
	Effective storage capacity	2,000,000 M^3
3.	Spillway	
	Length	56.00 M^3
	Head on crest	1.00 meter
	Capacity	123.00 cms

Benefit

This reservoir if built will provide enough water to convert 500 hectares of weather depending farm into 2-crop paddy field.

Transportation Facilities and Construction Materials

For the construction of this reservoir, a highway of 600 meters will be built. Suitable earth for the construction of the dam is available in the nearby region.

Ta-pu Reservoir (No. 55)
(See Fig. 199-200)

General Description

The proposed dam site is located on Ta-pu Chi, the main tributary of Tseng-wen Chi, about six kilometers upstream of the intake of Coral Lake Reservoir.

Tseng-wen Chi, 136.90 km in length, is one of the principal rivers in the south of Taiwan with a total drainage area of about 1,212 km^2. The drainage area of Ta-pu Chi above the proposed dam site is about 485 km^2. Ta-pu Chi has a slope of about 1 to 200 and the river bed is covered with gravels and boulders.

Water of Ta-pu Chi is rather clear, although land-slides have frequently happened along the banks of the river.

As proposed by the Japanese engineer, the proposed project consists of the construction of a 95-meter straight gravity overflow concrete dam to create a storage capacity of 200,000,000 cubic meters. The reservoir so created will have a water surface area of 800 hectares. It was proposed that the flood flow of Ta-pu Chi can be stored in this reservoir and utilized as supplementary supply of Chia-nan Canal System. It can also meet some demand for industrial uses and generate some power when transferring the water from this new reservoir into Coral Lake.

A report on this proposed dam site was written by Japanese Engineer in 1939 and the following maps are available in Tai-nan Hsien Government:

Topographical maps of the reservoir area: Scale 1:5,000

Topographical maps of the dam site: Scale 1:1,000

As estimated, about 95 hectares of farm land, 80 hectares of forest and 20 houses will be submerged if this project is undertaken.

Geology

At the proposed dam site, the rock is mainly Tertiary grayish brown sandstone and is hard and dense. The direction of the strike of the outcrops of both banks is N30°-40°E with dips of 32°, 33° or 36°. Some boring was made by the Japanese, but no record is available.

Hydrology

1. Rainfall

The following rainfall records are available:

1903 to 1945 records at Ta-pu Station.

1900 to 1943 records at Ta-pang Station.

1930 to 1940 records at Wang-lai-tse Station.

2. Stream Flow

Records at Wang-lai-tse Station during February 1938 - January 1940 are available.

3. Flood Estimate

The maximum flood discharge is about 3,395 cms.

Engineering Features

1. Dam

Type	Concrete graviety dam
Dam crest elevation	190.00 meters
River bed elevation	105.00 meters
Bed rock elevation	95.00 meters
Height of dam	95.00 meters
Crest length	305.00 meters
Volume of concrete dam	720,000 M^3

2. Reservoir

Drainage area	485.00 km^2
High water level elevation	185.00 meters
Maximum drawdown	45.00 meters
Total storage capacity	200,000,000 M^3
Dead storage capacity	13,540,000 M^3
Silt storage capacity for 35 yrs	68,690,000 M^3
Effective storage capacity	117,770,000 M^3

3. Spillway

Length	70.00 meters
Head on crest	10.00 meters
Capacity	4,430.00 cms
Gates	7 sets at 10^m x 10^m

4. Diversion Tunnel

A diversion tunnel is proposed to be built on the left bank of the river with a capacity of 550 cms. It has a length of 560 meters and is circular in shape with a diameter of 9 meters. The inlet of the tunnel will be at an elevation of 110 meters and the outlet at an elevation of 108.88 meters. ~~The slope is 1 to 500.~~

5. Power Generation

As proposed, water in the reservoir will be led to a proposed power plant in the downstream through a tunnel with a length of 6,550 meters. Under an effective head of 75 meters, power may be generated which will be treated later.

Cost

The construction cost of this project as estimated by the Japanese was $137,000,000 of Japanese Currency in 1939. In addition, a sum of ¥36,400,000.- was figured for soil conservation work.

Benefits

1. Irrigation

After the completion of this project, the inflow of Coral Lake will be increased by 277,000,000 M^3. As estimated by the Japanese engineer, the water for the irrigation of rice, sugar cane etc. will be increased in accordance with the following table:

Item	Available Water in 1,000,000 M^3 Before Carrying out Ta-pu Project	Available Water in 1,000,000 M^3 After the Completion of Ta-pu Project
Paddy	348	450
Sugar cane	90	120
Miscellaneous crop	0	60
Factory use	0	85
	438	715

The annual benefit was estimated to be $14,330,000 of Japanese Currency. It was further estimated that the benefit cost ratio of this project is 2.11 excluding the benefit from power sale.

2. Water power

Maximum power	31,050 kw
Firm power	6,210 kw
Average power.	13,450 kw

3. Flood Mitigation

As estimated, any flood flow of Ta-pu Chi can be stored in this proposed reservoir.

Transportation Facilities and Construction Materials

The present highway can only go up to Nan-hsi. Above Nan-hsi, one has to go on foot.

Stones and gravels scatter in the reservoir area and can be adopted as aggregates for concrete work.

Nan-hsi Reservoir (No.56)
(See Fig. 201 - 202)

General Description

The proposed dam site is located on a tributary of Ta-pu Chi, a tributary of Tseng-wen Chi, about 1.90 km to the northeast of Nan-hsi, Nan-hsi Hsiang, Tai-nan Hsien. After restoration, Hsin-hwa Regional Office of the Chia-nan Hydraulic Association made a survey on this project under the request of the local people. At present, the topographical maps of the reservoir and the dam site with a scale of 1 to 2,000 are available.

Geology

The rock in the drainage basin is mainly Tertiary grayish green soft shale and can be easily weathered. The direction of the strike of both banks is N70°W with a 3° dip.

Hydrology

1. Rainfall

Based upon the rainfall records during 1930 - 1940 at Wang-lai-tse Station, the annual mean rainfall is 2,803.10 mm. and the maximum daily rainfall is 526.70 mm. If the eighteen year records during 1936 at Nan-hsi Station are used, the annual mean rainfall is 2,759.72 mm. and the maximum daily rainfall is 301 mm.

2. Stream Flow

No record is available.

3. Flood Estimation

As calculated by emperical formula, the maximum flood discharge at the dam site is 15.34 cms.

Engineering Features

1. Dam

Type	Earth dam
Dam crest elevation	129.00 meters
River bed elevation	110.00 meters
Height of dam	19.00 meters
Crest length	64.00 meters
Volume of earthwork	34,000 M^3

2. Reservoir

Drainage area	1.42 km^2
High water level elevation	127.00 meters
Reservoir area	11.00 hectares
Total storage capacity	850,000 M^3
Effective storage capacity	850,000 M^3

Benefits

This proposed reservoir will provide irrigation water for 160 hectares.

Transportation Facilities and Construction Materials

There is no highway between Nan-hsi and the dam site.

Earth materials for the dam are available in the nearby area.

Kwei-tan Reservoir (No.57)
(See Fig. 203-204)

General Description

The proposed dam site is located on Kwei-tan Chi to the Northeast of Yu-ching Hsiang, Tai-nan Hsien. Kwei-tan Chi is a tributary of Ta-pu Chi, the main tributary of Tseng-wen Chi. The drainage area of Kwei-tan Chi above the dam site is about 17.96 km^2. The proposal consists of the construction of an earth dam to create a reservoir with a total storage capacity of 5,300,000 M^3 for the irrigation of 1,160 hectares. 12 hectares of sugar-cane field and 16 houses will be submerged if this reservoir is built.

Geology

The rock at the dam site is Tertiary gray sandstone. It changes to brownish yellow color after weathering. It is medium grained and hard. The direction of the outcrops of both banks is NS with a dip of 20^o-22^o.

Hydrology

1. Rainfall

The following rainfall records can be used for reference:

Station	Observation Period
Yu-ching	1903-1945
Wang-lai-tse	1930-1940
Nan-hsi	1936 to now

2. Stream Flow - Not available.

3. Flood Estimation

The maximum flood flow is estimated at 178 cms by emperical formula.

Engineering Features

1. Dam

Type	Earth dam
Dam crest elevation	103.00 meters
River bed elevation	75.00 meters
Height of dam	28.00 meters
Crest length	540.00 meters
Volume of Earthwork	79?,000.00 M^3

2. Reservoir

Drainage area	17.96 km^2
High water level elevation	100.00 meters
Reservoir area	51.00 hectares
Maximum drawdown	10.00 meters
Total storage capacity	5,300,000 M^3
Dead storage capacity	1,280,000 M^3
Effective storage capacity	4,020,000 M^3

3. Spillway

Length	70.00 meters
Head on crest	1.00 meter
Capacity	140.00 cms

Benefits

This reservoir if built will provide irrigation for 1,160 hectares of farm in Nan-hsi and Yu-ching region.

Transportation Facilities and Construction Materials

The Ping-lu-tao Kwei-tan Rural Highway and the light sugar railway both pass the dam site. The dam site is at a distance of 1.5 km from the Yu-ching Nan-hsi Highway, and can be easily connected to it if a branch road is built.

Keng-nei Reservoir (No. 58)
(See Fig. 205)

General Description

The proposed dam site is located at a gorge of Sha-tzu-tien Chi, to the east of Keng-nei-chuang, Yu-ching Hsiang, Tai-nan Hsien. Sha-tzu-tien Chi is a small tributary of Hou-ku Chi of Tseng-wen Chi System. The drainage area above the dam site is about 5.43 km^2. The water stored in the reservoir is proposed for the irrigation of 1,260 hectares in Yu-ching region.

A survey at the proposed site was made by Tai-nan Hsien Government in 1949 and the following maps are available:

Topographical maps of the reservoir: Scale 1:5,000

Topographical maps of the dam site: Scale 1:500

Topographical maps of the area to be irrigated: 1:1,200

10 hectares of land and 8 houses will be submerged if the reservoir is built.

Geology

The rock at the dam site is Tertiary grayish green sandy shale which is not hard and can be earily crushed.

The direction of the outcropsof both banks is N-S with 55° dip.

Hydrology

1. Rainfall

Based upon the records of Yu-ching Station during 1903 - 1945, the mean annual rainfall is 2,391.70 mm. and the maximum daily rainfall is 465 mm.

2. Stream Flow - Not available.

3. Flood Estimation

The maximum flood flow is estimated t be 57.2 cms.

Engineering Features

1.	Dam	
	Type	Earth dam
	Dam crest elevation	114.00 meters
	River bed elevation	84.00 meters
	Height of dam	30.00 meters
	Crest length	230 meters
	Volume of earthwork	129,900.00 M^3
2.	Reservoir	
	Drainage area	5.43 km^2
	High water level elevation	11 .00 meters
	Reservoir area	0.66 km^2
	Maximum drawdown	15.00 meters
	Total storage capacity	5,785,000 M^3
	Effective storage capacity	5,445,000 M^3
3.	Spillway	
	Length	15.00 meters
	Head on crest	1.20 meters
	Capacity	40.00 cms.

Benefits

This reservoir if built will convert 1,260 hectares of weather depending farm into irrigated paddy field.

Transportation Facilities and Construction Materials

A light sugar railsay is located close by the dam site. Furthermore the dam site can be connected with an existing highway if a new road of 2 km is built. Materials for the earth dam are available in closeby areas.

Na-pa-lin Reservoir (No.59)
(See Fig. 206 - 208)

General Description

Na-pa-lin Chi is the north tributary of Yen-shui Chi. It flows from the hilly district into plain area at Na-pa-lin, Hsin-hwa Hsiang, Tai-nan Hsien and then takes a westward course and meets Yen-shui Chi at the main railway bridge 3 kms south of Hsin-shih.

The proposed dam site is located at a gorge of Na-pa-lin Chi about one kilometer to the southwest of Na-pa-lin. The drainage area above the proposed dam site is 13.35 sq. km. A proposal was worked out by the Japanese engineer in the past which was based on maps of 1 to 25,000 scale.

Geology

The rock at the dam site is Tertiary brownish yellow and grayish yellow sandstone, medium grained and weak. The direction of the strike of the outcrops is N40° E with dip of 10° toward upstream.

Hydrology

1. Rainfall

Records of Hsin-hwa Station may be used for reference.

2. Stream Flow

A stream gauge was established at Na-pa-lin Highway Bridge on Na-pa-lin Chi. Records of observations since 1940 are available.

3. Flood Estimation

The calculated maximum flood flow at the proposed dam site is 310.00 cms.

Engineering Features

1. Dam

Type	Earth dam
Dam crest elevation	54.00 meters
River bed elevation	30.00 meters
Height of dam	24.00 meters
Crest length	162.00 meters
Volume of earthwork	172,800.- cubic meters

2. Reservoir

Drainage area	13.35 km^2
High water level	50.00 meters
Total storage capacity	9,600,000 M^3
Effective storage capacity	6,600,000 M^3

3. Spillway

Length	60.00 meters
Head on crest	2 meters

Cost Estimates

It was estimated by the Japanese engineer that the construction cost of the main dam and accessories is $801,000 and that of the diversion canal is $390,000, all of Japanese Currency.

Benefits

This reservoir, if built, can convert 1,680 hectares of weather depending land at Na-pa-lin and Shan-shang into irrigated land and can also reduce the flood damage of Yen-shui Chi. As estimated, the net profit for irrigation is $591,971 of Japanese Currency.

Transportation Facilitites and Construction Materials

A road about 1.5 kilometers long shall be opened to connect the dam site to Hsin-hwa Yu-ching Highway.

Yen-shui Reservoir (No. 60)
(See Fig. 209-210)

General Description

This project was investigated by the Reconnaissance Party in 1953 and was completed in 1955 with JCRR's loan fund. The dam is located on Chieh-tung Chi at a distance of 2.8 kilometers to the northeast of Hsin-hwa Hsiang, Tai-nan Hsien. Chieh-tung Chi is a tributary of Yen-shui Chi. Chieh-tung Chi has a drainage area of 5.36 km^2 above the dam site. At the dam site, there was a dam built by the Dutch but failed due to insufficient capacity of spillway.

Geology

The catchment area of the reservoir is composed of Tertiary brownish yellow and grayish yellow sandstone. Below the dam, it is composed of deposits of Quaternary system. At the dam site, yellowish redish, and greenish clay and loam are found.

Hydrology

When designing this project, rainfall records of Hu-tou-pi Station at a distance of 1.90 km to the south of the dam site were adopted. It was estimated that the time of concentration at the dam site is 0.84 hours, the rainfall intensity is 115.8 mm/hr. and the flood flow is 148 cms.

Engineering Features

1. Main Dam

Type	Earth dam with clay core wall
Crest elevation	33.00 meters
River bed elevation	16.00 meters
Height of dam	17.00 meters
Length	91.00 meters
Crest width	6.00 meters
Earth volume	41,472 M^3

2. Auxiliary dam

Height of dam (maximum)	2.63 meters
Length	624.5 meters
Width	4.00 meters
Earthwork	25,668 M^3

3. Reservoir

Drainage area	575 hectares
Water surface elevation when full	30.5 meters
Water surface area when full	21.8 hectares
Water surface elevation during storm	31.0 meters
Water surface area during storm	30.5 hectares
Total storage capacity	833,800.00 M^3
Effective storage capacity	753,800 M^3
Flood storage capacity (Between elevation 30.5 and elevation 31.00)	104,000 M^3

4. Spillway

Type	Radial gated spillway
Length	130.00 meters
Capacity	148 M^3/Sec.

Construction Cost

Engineering cost	=	NT$2,464,007.70
Right of way cost	=	230,000.00
Administration	=	30,800.00
Contingency	=	5,192.30
Total Cost	=	NT$2,730,000.00

Benefits

This reservoir provides supplementary water to 567.25 hectares of irrigated land. It is estimated that the net cost of annual increase of production is NT$1,400,000.-

Kwan-miao Reservoir (No. 61)
(See Fig. 211-212)

General Description

The proposed dam site is located north of Kwan-miao Hsiang, Tai-nan Hsien on the Hsu-hsien Chi, a tributary of Yen-shui Chi. Hsu-hsien Chi originates from Mt. Kwan-yin and joins Yen-shui Chi at Pa-chia. It has a total length of 15 km and an average slope of 1 to 120. The drainage area above the dam site is 38.80 km^2. As the farm lands totalling 3,170 hectares in Jen-teh Hsian, and Kwei-jen Hsiang are only partly irrigated by the existing Hsu-hsien Canal there are 2,068 hectares of weather depending farm in need of irrigation. This reservoir is planned to provide irrigation water for the weather depending land, to reduce the flood peak of Yen-shui Chi and to provide additional water supply to Tai-nan City. However 611 hectares of cultivated or forest land, 385 families and 2 km of highway will be submerged if this project is undertaken.

Geology

The reservoir area is mainly composed of sandstone and shale of the Tertiary system covered with diluvial deposit of Quaternary System. At proposed dam site No. 1, diluvial deposit is found and at site No. 2, sandy shale is found. The shale is greyish green in colour and is brittle and weak.

Hydrology

1. Rainfall

Rainfall records at Hsin-hwa Station since 1906 are available and the records at Tai-nan Station from 1904 to 1940 are also available.

2. Stream Flow

Run-off measurements at Kwan Miao were made during 1940 to 1944.

3. Flood Estimation

The estimated flood peak is 1,085 cms.

Engineering Features

1.	Dam	At Site No. 1	At Site No. 2
	Type	Earth dam	Earth dam
	Crest elevation	45 meters	45 meters
	Elevation of river bed	18 meters	28 meters
	Height of dam	27 meters	17 meters
	Crest legnth	344 meters	1,750 meters
	Volume of earth	455,000 M^3	1,645,000 M^3
2.	Reservoir		
	Drainage area		38.80 km^2
	High water level elevation		45.00 meters
	Maximum water level elevation		47.50 meters
	Total storage capacity		56,528,000 M^3
	Storage capacity for flood water		14,830,000 M^3
	Storage capacity for irrigation water		31,888,000 M^3
	Dead storage capacity		9,810,000 M^3
	Maximum reservoir area		6.34 km^2
3.	Spillway		
	Type		Morning Glory Type
	Diameter		4 meters
	Water depth above the Glory		2.50 meters
	Discharge capacity		120 cms.

Estimated Construction Cost (September, 1953)

Reservoir	NT$32,209,000
Irrigation	1,410,000
Water supply	16,178,000
Erosion control	2,455,000
Total	52,252,000

Estimated Benefits

1. Food Control

As planned, the flood flow of Hsu-hsien Chi will be reduced from 1,085 cms to 120 cms after this reservoir is built. It was further estimated that the flood flow of Yen-shui Chi will be reduced

by 25.8% at the confluence of the Hsu Hsien Chi and by 13.4% at the river mouth. The annual benefit through the reduction of flood damage is estimated at NT$10,000,000.

2. Irrigation

After the completion of this reservoir, 2,068 hectares of weather depending farm will be converted into 3-year rotation field and furthermore, some supplementary irrigation water will be provided to an area of 1,102 hectares which is now insufficiently irrigated. The total annual increase of agricultural production is estimated at NT$3,274,000.-

3. Water Supply

This reservoir will provide daily 20,000 metric tons of water to Tai-nan City. The annual benefit from water sale is NT$5,475,000.

Transportation Facilities and Construction Materials:

The dam site can be reached by a highway and earth materials for dam construction are available from nearby area. Sand and gravels are to be collected at far distance.

Shen-keng-tzu Reservoir (No.62)
(See Fig. 213-214)

General Description

The proposed dam site is located in the upper course of Shen-keng-tzu Chi, a tributary of Erh-tseng-hsing Chi, near Kwan-miao Hsiang, Tai-nan Hsien. The drainage area of Shen-keng-tzu Chi above the dam site is about 11.53 km^2. with an annual mean rainfal of about 2,000 mm. Survey work of this project was done by Chia-nan Hydraulic Association in 1946. The following maps and report are available.

Topographical maps of the dam site, Scale 1:500

Topographical maps of the reservoir area, Scale 1:2,500

A general project proposal on Shen-keng-tzu Reservoir.

Shen-keng-tzu Chi meanders in hilly region above the proposed dam site before running into the alluvial plain. The south branch of Shen-keng-tzu Chi above the dam site has a slope of 1:160 and the north branch has a slope of 1 to 110. The river bed of both creeks is covered by fine silt.

The area to be irrigated is about 3,300 hectares and is 10 km from the east to the west and 8 km from the north to the south. It lies at the elevation 8 to 13 meters.

This project if built will submerge 100 hectares of land in the reservoir area.

Geology

The rock in the drainage basin is Tertiary brownish or grayish yellow sandstone and is medium or coarse grained and weak in nature. In the downstream of Shen-keng-tzu Reservoir, alluvial deposits of younger stage are found and are covered with sandy loam and loamy sand.

Hydrology

1. Rainfall

   Kwei-tung Station: Rainfall records since 1903 are available.

   Hsin-hwa Station: Rainfall records since 1906 are available.

2. Stream Flow: No available record.

3. Flood Estimation:

North branch of Shen-keng-tzu Chi (Chung-keng-tzu Chi) 13.5 cms
South branch of Shen-keng-tzu Chi (Shen-keng-tzu Chi) 90.00 cms

Engineering Features

1. Dam

	On the south branch	On the north branch
Type	Earth dam	Earth dam
Crest elevation	45.00 meters	45.00 meters
River bed elevation	19.50 meters	21.50 meters
Height of dam	25.50 meters	23.50 meters
Crest length	135.00 meters	280.00 meters
Volume of earth	139,000 M^3	107,000 M^3

2. Reservoir

Drainage area	11.53 km^2
High water level elevation	42.00 meters
Reservoir area	169.60 hectares
Maximum drawdown	12.00 meters
Total storage capacity	10,555,000 M^3
Effective storage capacity	10,440,000 M^3
Connecting channel between two reservoirs	1.00 km

3. Spillway

Spillway crest length	43.00 meters
Designed head on crest	1.00 meter
Spillway capacity	95.03 cms

Benefits

After this reservoir is built, the water will be utilized to convert 3,300 hectares of weather depending land into 3-year rotation farm. As estimated by the Association, the benefit cost ratio of this project is 4.65.

Transportation Facilities and Construction Materials

The dam site can be reached by a rural highway. It connects with the main railway and highway at Hsin-shih, Tai-nan Earth dam construction material is available near the dam site. However the aggregates for concrete work should be hauled in from for outside.

Wu-shan-keng Reservoir (No.63)
(See Fig. 215)

General Descri tion

The pro,osed dam site is located on a tributary of Brh-tseng-hsing Chi, about one kilometer to the northwest of Shi -che, Nei-men Hsiang, Kao-hsiun, Hsien. The draina,e area above the pro,osed site is about 2.31 square kilometers with a mean annual rainfall of about 2,100 mm. and a minimum annual rainfall of about 1,063 mm.

This reservoir is pro,osed f.r domestic water su,,ly and irrigation ,ur,oses. As Nei-,en Hsian, is surrounded by mountains, and all cultivated land is weather de,ending without water su,,ly, ,eo.le in this area have to di, well in the river bed durin, February and May in order to ,et some water for their home use. In 1950, a number of wells were du, to a de,th of 100 meters and no artesian water was reached. It was re,orted that water can only be reached at a de,th of 400 meters. The local ,eo,le can not afford such dee, ex,ensive well.

Geology

The reservoir basin is com,osed of Tertiary ,rayish green shaly sandstone which is wea in quality and can be easily weathered. The to,ogra,hic a,,earance is not ,ood. The direction of the strike of the outcro,s alon, the dam site is N20° E. with di,s of 78°.

Soils in the area to be irrigated are planosoils. There is an olive gray to dive colored hard ,an with a thickness of about 35 - 50 centimeters at a de,th of 20 - 35 centimeters below the ground surface. Its structure is prismatic, reaction is neutral to slightly alkali and texture is heavy. The surface soils are usually pale olive to olive in color, slightly acid to neutral in reaction, cloddy, single grain and granular in structure and slightly heavy in texture. Layers below the mentioned hardpan are yellowish brown or grayish brown in color, alkali in reaction, massive in structure and heavy in texture. The soils of the area to be irrigated are clay loam and silty clay loam.

Hydrology

1. Rainfall

   Records durin, 1903-1945 of the Kwei-tun, Station are available.

2. Stream Flow: None

3. Flood Flow: As estimated by em,erical formula, the maximum flood flow is about 24.26 cms.

Engineering Features

1. Main dam

Type	Earth dam
Dam crest elevation	105.50 meters
River bed elevation	84.00 meters
Height of dam	21.50 meters
Length of dam crest	195.00 meters
Volume of earthwork	147,000 M^3

2. Reservoir

Drainage area	2.31 km^2
High water level elevation	103.50 meters
Reservoir area	0.67 km^2
Dead water level	94.00 meters
Total storage capacity	6,850,000 M^3
Effective storage capacity	4,850,000 M^3

Benefits

This reservoir, besides providing water for domestic use, will irrigate an area of 500 hectares.

Transportation Facilities and Construction Materials

There is a rural highway from Chi-shan to Nei-men. A highway of 1.5 km is to be opened from Nei-men to the dam site.

Remarks:

The drainage area of this reservoir is too small for such a big reservoir.

Erh-tseng-hsing Reservoir (No. 64)
(See Fig. 216-219)

General Description

The proposed dam site is located on the Erh-tseng-hsing Chi, north of Mt. Ta-kang, A-lien Hsiang, Kao-hsiung Hsien. This project is aimed to irrigate Hsin-feng, Kang-shan and Nan-tzu region at the downstream.

Planning work of this project was started in 1908 by Japanese engineers. For the purpose of drawing water from Nan-tzu-hsien Chi to this proposed reservoir, a flume of several hundred meters in length and a tunnel with a capacity of 20 cms were built, but not yet used. The drainage area of Erh-tseng-hsing Chi above the dam site is about 142.00 km^2. It has many tributaries. The longest one is 36 km in length with an average river bed slope of 1 to 360.

Some surveying work was done in 1949 by the Provincial Water Conservancy Bureau and the following maps are available:

Topographical maps of the reservoir, Scale 1 : 2,500
Topographical maps of the dam site, Scale 1 : 500

In addition, 13 exploration holes were drilled along the dam site to a depth of 30 meters. Records of drilling are available in the PWCB.

This project if carried out will submerge 680 hectares of cultivated or dry land, 200 hectares of forest and bamboo and 600 farm houses.

Geology

Rocks are mainly Tertiary grayish green sandy shale and shaly sandstone, soft and weak, and can be easily weathered. The logs of the boring hole show sandstone and shale at the upper part and then a layer of limestone with shells and corals up to a depth of 18 meters. From 18 meters down, are sandy shales.

Hydrology

1. Rainfall

Station	Available Records
Kang-shan	1921 to now
Kwei-tung	1903 to 1945
Chi-shan	1904 to 1945

2. Stream Flow

A stream gauge was installed at A-lien in 1940 and observation was made during 1940 - 1942.

Pertaining the discharge observation of Nan-tzu-hsien Chi, reference is to be made to the Mei-nung Reservoir Project.

3. Flood Estimation

As estimated, the discharge at the proposed dam site is about 810 cms.

Engineering Features

1. Dam

Type	Earth dam
Dam crest elevation	49.20 meters
River bed elevation	4.20 meters
Height of dam	45.00 meters
Length of crest	200.00 meters
Dike (average 4 meters in height)	1,600.00 meters
Volume of earthwork	870,000 M^3

2. Reservoir

Drainage area	142.00 km^2
High water level elevation	43.50 meters
Dead water level elevation	35.00 meters
Reservoir area	15.20 km^2
Total storage capacity	300,000,000 M^3
Dead storage capacity	85,000,000 M^3
Effective storage capacity for irrigation	160,000,000 M^3
Effective storage capacity for flood control	55,000,000 M^3

3. Spillway

Type	Shaft
Diameter of shaft	4.00 meters
Spillway crest elevation	43.50 meters

Head	2.70 meters
Capacity	192.00 cms

Benefits

1. Irrigation: This reservoir, if built, can provide irrigation for 18,126 hectares with a following breakdown:

Hsin-feng district	5,659 hectares
Nan-tzu-hsien district	5,315 hectares
North Kang-shan district	7,152 hectares
Total	18,126 hectares

2. Flood Control: The flood flow of Erh-tseng-hsing Chi will be reduced from 810 to 192 cms if this project is carried out.

Transportation Facilities and Construction Materials

Both main railroad and highway are not far from the dam site. Earth for dam construction is available in nearby areas. Aggregates for concrete work have to be brought in from outside.

Remarks: This reservoir can be connected with the existing T-kung-tien Reservoir by a tunnel.

The erosion problem of the drainage area is very serious. Unless some control work can be done, it seems to be unwise to start this construction work too early.

A-kung-tien Reservoir (No. 65)
(See Fig. 220)

General Description

This is a finished project. The dam is located on the A-kung-tien Chi at the foot hill of Mt. Hsiao-kang, Chu-tzu-chiao, Yen-chao Hsiang, Kao-hsiung Hsien. A-kung-tien Chi originates from the hilly land at the south of Mt. A-li and flows westward to Kang-shan and meets Sheng-fan-lai Chi before entering the sea. The length of A-kung-tien Chi is 38 km with a total drainage area of 153 km^2 of which 80% is flat land. This project was planned by Japanese. Construction work was started in 1942 but was washed away by flood in 1944. It was resumed in September 1946 by the Chinese Government and completed in 1951. This reservoir is multiple purpose in nature, besides mitigating the flood flow, it supplies water for irrigation and domestic use.

Geology

Rocks of the reservoir area are sandstones and shales of the Tertiary system. The foundation of the dam is on greenish gray sandstone which is coarse and weak in nature.

Hydrology

1. Rainfall: Records at the following stations are available.

   Ta-kang-shan Station: From 1921 - 1940.

   Shen-shui Station: From 1904 - 1945.
   At Shen-shui Station, the maximum daily precipitation was 505.2 mm and 2-day precipitation was 645.2 mm.

2. Stream Flow: No record.

3. Flood Estimate: The estimated flood flow at the dam site is 300 cms.

Engineering Features

1. Dam

Type	Earth dam
Dam crest elevation	42.00 meters
River bed elevation	11.00 meters
Height of dam	31.00 meters
Crest length (Main dam)	200.00 meters

Length of auxiliary dam:		
Left side		1,835.00 meters
Right side		345.00 meters
R. C. Corewall:	Height	31.5 meters
	Width	0.5 meter
	Length	492.0 meters

2. Reservoir

Drainage area	30.50 km^2
Reservoir area	3.96 km^2
High water level elevation	34.50 meters
Maximum high water level elevation	38.00 meters
Dead water level elevation	26.00 meters
Dead storage capacity	4,500,000 M^3
Irrigation storage capacity	10,000,000 M^3
Water supply storage capacity	3,500,000 M^3
Flood control storage capacity	10,000,000 M^3
Additional storage from the flood level to the top of the dam	17,000,000 M^3
Total storage capacity	45,000,000 M^3

3. Spillway

Type	Shaft type
Crest elevation	34.50 meters
Diameter of shaft	3.00 meters
Designed maximum discharge	81.6 M^3/Sec

4. Irrigation Intake

Designed capacity	3.4 cms
Diameter of conduit	1.5 meters

Benefits

1. Flood Control: The total area protected against flood is 5,000 hectares.

2. Irrigation: This reservoir can provide water for 2,400 ha. of double crop paddy field and 3,600 hectares of rotation irrigation field.

3. Water Supply: A storage of 3,500,000 M^3 is allocated for water supply use. This is enough for an additional 50,000 persons in Kang-shan district.

Pei-shih-lin Reservoir (No. 66)
(See Fig. 221 - 222)

General Description

The proposed dam site is located on Chung-chi Chi, a tributary of Hou-ching Chi, to the east of Feng-shan-tso, Chiao-tou Hsiang, Kao-hsiung Hsien. Hou-ching Chi is a small river in Kao-hsiung with flat slope and high silt content. Lands at its downstream are flooded frequently during storm periods.

The drainage area of Pei-shih-lin Chi above the dam site is 12.54 sq. km with an average annual rainfall of about 2,000 mm.

The survey work was carried out by Chiao-tzu-tou Sugar Factory with the following maps done.

Topographical map of reservoir area - Scale 1 : 2,500

Topographical map of dam site - Scale 1 : 500

In the reservoir area, there are 30 hectares of cane field, 25 hectares of public land, 95 hectares of dry land and 80 farm houses which will be submerged if a dam is built.

Geology

Rocks are mainly blue sandstones of Tertiary system which are fine grained and dense. The direction of the strike of the outcrops is N20° - 30°E with dip of 60° toward upstream.

Hydrology

The maximum flood discharge at the dam site is estimated to be 116 cms.

Engineering Features

1. Main dam

Type	Earth dam
Dam crest elevation	45.00 meters
River bed elevation	26.00 meters
Height of dam	19.00 meters
Crest length	250 meters
Total length of auxiliary dikes	2,000 meters
Average height of auxiliary dikes	3.50 meters
Volume of earth work	240,000 M^3

2. Reservoir

Drainage area	12.54 km^2
Reservoir area	150.00 hectares
High water level elevation	42.00 meters
Dead water level elevation	35.00 meters
Total storage capacity	9,500,000 M^3
Dead storage capacity	2,000,000 M^3
Effective storage capacity	7,500,000 M^3

3. Spillway

Lengh	35.00 meters
Head	1.00 meter
Capacity	78.00 cms

Benefits

1. *Irrigation:* 1,200 hectares of cane field and dry land in Chiao-tzu-tou region will be provided with irrigation.

2. Flood Mitigation: The flood hazard at the downstream of Hou-ching Chi can be minimized.

Transportation Facilities and Construction Materials

The branch road about 1 km long joining the dam site to Chi-shan Liao-hsiung Highway has to be improved. Earth materials for dam construction are available nearby the proposed dam site.

Remarks: At the same dam site, there are two more project proposals. One proposal planned by the Japanese engineer covers the construction of an earth dam with a height of 21.50 meters to store 19,160,000 M^3 of water for the irrigation of 1,330 hectares and the other proposal planned by the Sugar Factory covers the construction of an earth dam with a height of 24 meters at a total cost of NT$14,000,000 to store 23,600,000 M^3 of water for the irrigation of 2,000 hectares.

Chia-jui-chi Reservoir (No. 67)
(See Fig. 223)

General Description

The proposed dam site is located on Chia-jui-chi Chi to the north east of Chia-jui-chi Tsun, Ta-she Hsiang, Kao-hsiung Hsien. The drainage area above the dam site is 6.67 km^2 with an average rainfall of about 2,000 mm. As planned by the Japanese engineer, a storage of 6,450,000 M^3 can be obtained if an earth dam with a height of 17 meters is built. This amount of water is enough for the irrigation of 500 hectares at the downstream. The proposal as detailed below is based upon the study made by the surveying party. Seventy hectares of dry land, 100 hectares of forest and 35 farm houses will be submerged if this reservoir is built.

Geology

Rocks in the reservoir area are greenish gray sandstones of Tertiary system covered up with deposits of quaternary system. At the dam site, sandstones are weak in nature with indistinctive layers. The soil to be irrigated is sandy loam.

Hydrology

1. Rainfall: Records of Kang-shan Station during 1921 to 1953 were used for reference by the Reconnaissance Party.

2. Stream Flow: No data available.

3. Flood Estimatation: The estimated maximum flood discharge is 62.70 cms.

Engineering Features

1.	Dam	
	Type	Earth dam
	Dam crest elevation	62.00 meters
	River bed elevation	50.00 meters
	Height of dam	12.00 meters
	Length of crest	150.00 meters
	Auxiliary dam (average height 5 meters)	700.00 meters
	Volume of earth work	125,000 M^3
2.	Reservoir	
	Drainage area	6.67 km^2

High water level elevation	60.00 meters
Reservoir area	1.85 km^2
Total storage capacity	7,600,000 M^3
Flood storage capacity	1,300,000 M^3
Irrigation storage capacity	5,300,000 M^3
Dead storage capacity	1,000,000 M^3

3. Spillway

Length	19.00 meters
Elevation of crest	59.00 meters
Height of gates	1.00 meter
Discharge capacity	42.00 cms

Benefits

1. Irrigation: This reservoir will provide irrigation for an area of 500 hectares in Ta-she region.

2. Flood Mitigation: This reservoir will provide a storage of 1,300,000 M^3 for flood storage.

Trsnsportation Facilities and Construction Materials

The dam site is at a distance of 2 km to the Kao-hsiung Chi-shan Highway. The construction work of such highway is simple. Earth materials are available in the nearly region of the dam site.

Shih-lung Reservoir (No. 68)
(See Fig. 224-225)

General Description

The proposed dam site is located on Shih-lung Chi, a tributary of Hou-ching Chi, at Chien-pu-tso, Jen-wu Hsiang, Kao-hsiung Hsien. The drainage area above the proposed dam site is 9.4 sq. km with an average annual rainfall of 2,000 mm. At the proposed site, an earth dam had been built by the local people about hundred years ago, but was damaged by flood. The ruined spillway is still traceable at the proposed site.

This reservoir as planned can irrigate an area of 800 hectares, of which 300 hectares are under the existing Tsung-tu-pi irrigation system with insufficient water supply and the other 500 hectares are just dry lands. Forty hectares of cultivated or dry land and 2 houses will be submerged, when this reservoir is built.

Geology

Rocks at the dam site are gray sandstones of the Tertiary system, which are medium grained and hard in nature covered with alluvial disposits of Quaternary system. The direction of the strike of the outcrops is N78°E at both banks with 45° dip toward upstream.

Hydrology

1. Rainfall: Records of Kang-shan Station during 1921 to 1953 were used for reference.

2. Stream Flow: No record is available.

3. Flood Estimation: The estimated discharge at the dam site is 88.40 cms.

Engineering Features

1. Dam

Type	Earth dam
Dam crest elevation	61.00 meters
River bed elevation	43.00 meters
Height of dam	17.50 meters
Crest length	200.00 meters
Auxiliary dike	1,000 meters
Volume of earth dam	550,000 M^3

2. Reservoir

Drainage area	9.40 km^2
High water level elevation	59.00 meters
Reservoir area	2.00 km^2
Total storage capacity	13,600,000 M^3
Irrigation storage c city	9,200,000 M^3
Flood storage capacity	2,600,000 M^3
Dead storage capacity	1,800,000 M^3

3. Spillway

Length	27.00 meters
Spillway crest elevation	58.00 meters
Height of gates	1.00 meter
Discharge capacity	59.00 cms

Benefits

1. Irrigation: The reservoir can provide supplementary water to 300 hectares of irrigated land and complete irrigation to 500 hectares of dry land.

2. Flood Mitigation: A flood storage capacity of 2,600,000 M^3 will provide some protection against flood to the downstream area.

Trsnsportation Facilities and Construction Materials

Both Kao-hsiung Chiu-chu-tang Highway and the light-track railway are quite close to the proposed dam site. Earth materials for the dam and gravels for the concrete work are available at the dam site.

Hsia-tan-shui Chi Basin
(See Fig. 226-227)

General Description

Hsia-tan-shui Chi originates from Mt. Hsin-kao, the main peak of the Central Range. It flows southward and enters the Formosa Strait. It has four main tributaries, namely Lao-nung, Nan-tzu-hsien, Cho-kow and Ai-liao.

The total length of the river is about 170 km and the total drainage area is 3,194.36 square kilometers.

The upper stretch of the river flows in mountainous region and gorges. Terraces can only be found along its middle course. The lowest stretch of the river is on the Ping-tung and Kao-hsiung alluvial plains. The river slope at upper course is 1 to 30, middle course 1 to 200 and lower course 1 to 1,500.

Geology

The northeastern and the southeastern parts of the river basin are mainly composed of slates and hard dark greyish sandstones of the Tertiary system. The east side of the Central Range is covered up by brilliant, medium grained sandstones and shales of Tertiary system. Diluvial deposits of Quaternary system can be seen as a belt on the rolling hills at the south side of the river from Chi-shan to Feng-shi-tou, south of Hsiao-kang. Alluvial fans are either river or marine deposits. Detrital materials brought down by the river during flood flow period are sourced from bank sloughings at the upper valleys, of which Lao-nung Chi valley is the most important one. Nan-tzu-hsien Chi has a better natural coverage and the forest there is one of the well-known forests in Tai-wan.

Precipitation

Rainfalls occur principally in the period from June to August and are more intensive at the time when typhoons visit this island. The average annual rainfall of the four main tributaries are tabulated as follows:

Name of Creek	Upper Course		Middle Course		Lower Course	
	Station	Annual Rainfall in mm	Station	Annual Rainfall in mm	Station	Annual Rainfall in mm
Lao-nung		4,500*		3,000*		3,000*
Nan-tzu-hsien	Wen-tzu-chih	3,412	Chia-hsien	3,157	Chung-tan	2,960
Cho-kow		4,000*		3,500*		3,000*
Ai-liao	A-tui-lu	4,814	Te-wen	4,170	San-ti-men	3,000

*Estimated figures.

Temperature

The temperature variation of this river basin is rather great. The lowest temperature at Mt. Hsin-kao is or below 0°C. Snowfall occurs occasionally during winter time. The annual mean temperatures at Lao-nung, Chia-hsien and Te-wen are 24.7°C, 24.3°C and 21.3°C respectively. Down to the alluvial basin, the recorded annual mean temperatures are 24.3°C and 25.2°C at Ping-tung and Feng-shan.

River Flow

The river stage of Hsia-tan-shui Chi in ordinary years, follows a pattern that (a) the water level of the river begins to rise from March; (b) it will keep at high stage during June to August and begins to recede in September and (c) the low stage begins from December until February of next year.

Based upon the past records, the runoff per 100 km^2 of watershed area of the four main tributaries are estimated and tabulated as follows:

Name of Creek	Runoff in C.M.S. Per 100 km^2 of Watershed Area			
	At a Q (River Discharge) kept at or over 355 days	At a Q kept at or over 275 days a year	At a Q kept at or over 185 days a year	At a Q kept at or over 95 days a year
Lao-nung	1.44	3.06	6.98	14.63
Nan-tzu-hsien	0.66	1.38	5.09	11.80
Cho-kow	0.91	1.71	4.88	13.24
Ai-liao	0.58	-	2.94	14.43

Available Data

Topographic Maps

Maps with scales 1 to 50,000 for mountainous region and 1 to 25,000 for plains surveyed by the Japanese and reprinted by the U. S. Army are available. Maps with scales 1 to 20,000, 1 to 6,000 or 1 to 2,000 for some particular areas may also be obtained from the local Hydraulic Associations, or Hsiang, Hsien or city governments.

Hydrological Data

Among the 20 river gaging stations one has silt content records and 13 were abolished. There were 17 rainfall stations. The names, locations and available observation records of the above stations are tabulated below.

The following are facts to be observed when the records of these stations are referred to.

a. Since the observation stations were not equipped with automatic recorders, peak flow or high intensity rainfall records could easily be missed.

b. Due to the fact that permanent control sections are scarce and hard to find, the sections where the river gaging stations are located may change from time to time. At such locations, the rating curves adopted should also be modified from time to time. Due to the financial limitation, this requirement could not be met by the Stations in the past and it is still a problem to be solved to-day. In other words, the available records ought to be used with precaution.

c. The rainfall gaging stations are not well distributed. For catching intensive rainfall in mountain regions, more rainfall gaging stations with automatic recorders should be established.

d. For getting more information on silt content of river water, more silt measurement at different river gaging stations should be made.

A. River Gaging Stations

Main or Tributaries	Location of Station	Observation Period	Remarks
Main	Shan-tzu-chiao	Dec. 1940-Dec. 1942	
Main	Li-yu-shan	Aug. 1913-Sept. 1941	
Main	Chiu-chu-tang (Chuan-tzu-yao)	Mar. 1940-Dec. 1942	
Main	Chiu-chu-tang	Apr. 1915-Oct. 1929 Jun. 1948-present	With silt content observation
Main	Chu-tzu-liao	May 1915-Jul. 1929	
Nan-tzu-hsien	Shan-shan-lin	Jun. 1910-Jul. 1929	
Nan-tzu-hsien	Shih-chang-li	Nov. 1938-Dec. 1941 1947 - present	
Nan-tzu-hsien	Hsiao-lin	Oct. 1938-Sept. 1940	
Lao-nung	Liu-kwei-li	Nov. 1915-Oct. 1926	
Lao-nung	Hsin-kai	Sept. 1920-Oct. 1941 1947 - present	
Lao-nung	Yen-erh	Oct. 1924-Jul. 1926 Oct. 1938-Jul. 1940	
Lao-nung	Mei-piao	Sept. 1925-Dec. 1926 Jun. 1939-Dec. 1945	
Cho-kow	Wei-liao	Nov. 1913-Dec. 1917 Jan. 1947 - present	
Cho-kow	Ta-tsin	May 1940-Dec. 1942	
Cho-kow	Wen-tzu-chih (Ma-kai Tsun)	Nov. 1925-Dec. 1926 Dec. 1938-Dec. 1945	
Ai-liao	Ai-liao	Jul. 1926-Sept. 1931 Dec. 1938-Jan. 1943	
Ai-liao	Pai-ko-hai She	Dec. 1938-Oct. 1940 Jan. 1947 - present	
Ku-hsia	Kow-she	Mar. 1940-Dec. 1942	
Ku-hsia	Wan-tan	Jan. 1947 - present	
Wu-lo	Chang-pan Tsun	Mar. 1940-Sept. 1942 Jan. 1947 - present	

B. Rainfall Gaging Stations

Main or Tributaries	Location of Station	Observation Period	Remarks
Main	Ping-tung	1904-1945	
Main	Feng-shan	1901-1945	
Nan-tzu-hsien	Wen-tzu-chih	1912-1945	
Nan-tzu-hsien	Chia-hsien	1904-1945	
Nan-tzu-hsien	Chung-tan	1915-1945	
Nan-tzu-hsien	Chi-shan	1904-1945	
Lao-nung	Ta-tung-kwan	Jan. 1923	
Lao-nung	Yen-erh	1910-1945	
Lao-nung	Hsin-wei	1904-1945	
Lao-nung	Chung-chih-kwan	Feb. 1939	
Lao-nung	Pao-lai	May 1947	
Lao-nung	Lao-nung	1904-1944	
Lao-nung	La-po-lan	Feb. 1940	
Cho-kow	Chi-nan-shan	Sept 1939-Dec. 1941	
Ai-liao	Te-wen	1912-1945	
Ai-liao	A-tui-lu	Mar. 1939	
Ai-liao	San-ti-men	May 1947-1953	

Geology and Soil

A. A number of investigations on geology of this river basin were made by the Japanese. The following maps are available for reference:

1. Maps on Taiwan Mineral Resources (by Ichikawa, R; Scale 1 to 300,000)

2. Maps and Reports on the Geological Distribution of Taiwan (Scales: 1:20,000 to 1:30,000, Year 1932)

The geological distribution maps and reports were prepared by the Japanese with the principal aim to locate petroleum resources. The investigations made covered quite a broad field including geographic features, geology, geological structures, oil-bearing strata, etc. Maps and reports on oil investigation of Chia-hsien, Chi-shan, and Hsin-hwa areas are especially good for reference of this river basin.

B. For getting soil information, the available "General Map on Soil Characteristics in Taiwan" and the report on soils in Kaohsiung Prefecture may be referred. The latter report was published by the Taiwan Agricultural Research Institute in 1953 based upon the survey made during 1949-1951. This report covers information on soil classification, characteristics, distribution, chemical and mechanical composition, fertility, utilization and management.

Pertaining to the control of soil erosion, an investigation was made during 1937-1940 and information on river channel conditions, forest covers, and possible check dam sites with topographic maps of Scale 1:500 was collected.

Water Power

Water power investigations were made by the Japanese during 1936-1940 and information on the river discharge, the meteorological conditions, the topographical features and the availability of water power was collected. Reports of these investigations were in Japanese and have been translated into Chinese and filed in the Taiwan Provincial Water Conservancy Bureau. Projects as proposed in the report are mainly of run-of-river type without enough consideration on the possibilities of building reservoirs.

Basin Wide Development Program

Based upon the above general investigation, it can be seen that there is a very low irrigation demand and a high power development feasibility along the tributaries of the Hsia-tan-shui Chi as the tributaries are all in narrow gorges with steep slopes. However, along the main river the demand of water for irrigation is high as the river plain is in need of water either as supplementary supply to meet the present deficit or for areas to be developed. The feasibility of developing water power along the main river is low as the river bed is flat. It seems to be advisable that an overall program should be worked out in order to reach the most beneficial development. The details on individual reservoir sites investigated are reported later. Some general information on the existing work is given as follows.

Flood Control

The dike construction program of the Hsia-tan-shui as proposed by Japanese was completed during 1925-1938. Before 1925, Kwei-shan Dike along the right bank of the Lao-nung Chi, Fu-hsing Dike along the left bank of the Ai-liao Chi and Liu-kwai-tso Dike at the right bank of the main river were built on piece-meal basis. The program completed during 1925-1938 covered dike construction for 45,000 meters along the two banks of the main river as detailed below:

(1) Extending the Fu-hsing Dike to Li-kang to confine and combine the branch channels of the Ai-liao and Wu-lo Chi for the protection of Ping-tung Plain.

(2) Extending the Kwei-shan Dike to San-chang-kuo for the purpose of confining and combining the branch channels of the Lao-nung Chi.

(3) Extending and constructing dikes along the Hsia-tan-shui Chi to the river mouth.

After this program was completed, besides over 19,000 hectares and over 30,000 persons having been protected against flood hazards, over 8,900 hectares of new land were obtained, of which 6,000 hectares can be reclaimed into productive land.

The following figures on the maximum discharge, the river grade, the dike spacing, the bank slope and the free board, were adopted by this diking program.

(1) Adopted Max Discharge Figures:

At the junction of Ai-liao Chi and Wu-lo Chi = 4,200 cms.

At the junction of Ai-liao Chi and Lao-nung Chi = 5,600 cms.

At the junction of the main river (Lao-nung Chi) and the Ai-liao Chi = 11,000 cms.

At the junction of the main river (Lao-nung Chi) and the Nan-tzu-hsien Chi = 16,000 cms.

At the river mouth of Hsia-tan-shui = 22,000 cms.

(2) Adopted River Grade Figures:

Ai-liao Chi above the junction with the Lao-nung Chi = 1:600

Ai-liao Chi below the junction with the Lao-nung Chi = 1:600

Hsia-tan-shui Chi nearby the junction with the Nan-tzu-hsien Chi = 1:1,100

Hsia-tan-shui Chi nearby the river mouth = 1:1,200

(3) Adopted Dike Spacing Figures:

Nearby Li-kang = 1,500 meters

Below Ling-kow = 1,800 meters

Ai-liao Chi = 900 meters

(4) Adopted Dike Sections:

Above Chuan-tzu-yao, gravel dikes were built with a top width 3.6 meters, freeboard 1.8 meters and side slope 2:1 (H:v).

Below Chuan-tzu-yao, earth dikes were built with a top width 5.5 meters, freeboard 1.2 meters, river side levee slope 2.5:1 (H:v), a berm 3.6 meters in width 3 meters below the top, and land side levee slope 3:1.

Since the completion of this project, repair work was done every year. Furthermore, more revetment work and spur dikes were added for the protection of the finished dikes. Up to 1952, there were 11,525.50 meters of gravel dikes, 69,089.26 meters of earth dikes, 4,258.70 of revetment with gravels or wire sausages and 326 units of spur dikes. It has been found that the river bed is aggrading year by year. For the purpose of reducing the flood flow by storage, several reservoir sites were found and investigated.

Water Power

The water power development work of this river basin was started quite early but discontinued shortly afterwards. Up to date, there are only two power plants, one is the Chu-tzu-men power plant completed in 1908 and the other is the Tu-lung-wan power plant completed in 1917.

Chu-tzu-men power plant is located at Chu-tzu-men, Mei-nung Chen, Kao-hsiung Hsien and is the earliest one on this island. The intake of this plant is located at the right bank of the Lao-nung Chi with a maximum capacity of 10 cms. The effective head of this plant is 22.75 meters. The power outputs of this plant are 1,950 kw, 900 kw and 750 kw at maximum discharge 10 cms, average discharge 4.62 cms and minimum discharge 4 cms respectively. The tailrace water supplies the Shih-tzu-tou Canal to irrigate the Mei-nung plain for 3,720 hectares of two crop and 535 hectares of single crop rice field. This plant has two vulnerable points and is subject to possible future modifications. One of the defects is that the diversion work is temporary in nature and the failure of which can happen any time during the high flow period and renders the service of this plant unreliable. Furthermore, an intake for the irrigation of Kao-shu area is situated at the left side of the Lao-nung Chi. The struggle for water between these two intakes during low water period is also a problem to be solved.

Tu-lung-wan power plant is located along the Lao-nung Chi opposite Liu-kwei-li, Kao-hsiung Hsien. For the purpose of diverting water, a concrete dam 5 meters high was built but lately damaged.

The present intake for taking in water from Lao-nung Chi is located at Chung-tzu-pu about 4 km upstream from the power station. The effective head of this plant is 30 meters. The maximum and minimum outputs are 3,100 kw and 1,500 kw at maximum discharge of 15.72 cms and minimum discharge of 5.00 cms respectively.

An investigation on water power sources in this river basin was made during 1935-1939 with a result as tabulated on next page.

Proposed Water Power Plant Stations in Hsia-tan-shui Chi Basin

No.	Name of Creek	Intake at	Tail Race at	Quantity of flow in cms	Effective Head in m	Output in kw	Length of conduit in m	Catchment area in km^2	Remarks
1	Lao-nung	Ta-me-huo She Chi-shan		M* 8.50 Y* 6.99	392.0	M 28,409 Y 23,295	5,500	141.42	Run of river type
2	"	Chi-shan	Chung chih kwan, Chi-shan	M 24.00 Y 18.56	108.0	M 21,084 Y 15,391	2,500	278.27	Run of river type with a diversion weir
3	"	Chung-chih-kwan	Me-szu-huo-wa-lu She	M 24.50 Y 18.95	249.50	M 52,117 Y 40,130	7,700	285.69	Run of river type
4	"	Me-szu-huo-wa-lu She	Mei-piao Chi-shan	M 30.80 Y 24.15	87.00	M 21,796 Y 17,000	7,700	391.57	do.
5	"	Mei-piao	Yen-er She Chi-shan	M 36.00 Y 28.46	115.00	M 34,080 Y 26,923	7,000	480.77	do.
6	"	Yen-erh She	Pao-lai Liu-kwei	M 40.00 Y 31.73	132.70	M 43,435 Y 34,314	9,300	546.41	do.
7	"	Pao-lai	Shih-liu-kwei-eh-tou Liu-kwei	M 50.00 Y 40.37	77.50	M 31,519 Y 25,215	11,160	738.47	do.
8	"	Shih-eh-tou	Shih-men Shuang-chi	M 54.00 Y 43.86	119.50	M 53,121 Y 43,028	10,400	805,22	do.
9	"	Shih-men	Shuang-chi Mei-nun	M 56.00 Y 47.33	73.50	M 33,480 Y 25,780	2,800	812.84	Run of river type with a diversion weir.

No.	Name of Creek	Intake at	Tail Race at	Quantity of flow in cms	Effective Head in m	Output in kw	Length of conduit in m	Catchment area in km^2	Remarks
10	Nan-tzu-hsien	Ta-chia-nu-wa She	Wen-tzu-chih	M 11.20 Y 7.97	202.0	M 18,402 Y 13,066	9,500	225.40	Run of river type with a diversion weir.
11	"	Chi-shan An-wa-na	Tung-a-li-kwan	M 15.00 Y 10.95	157.0	M 19,156 Y 13,984	9,200	335.84	Run of river type.
12	"	Tung-a-li-kwan	Tung-ta-chiu-yuan Chia-hsien	M 15.00 Y 10.95	120.0	M 14,465 Y 10,559	10,700	335.84	do.
13	Cho-kow	Ka-li-sheng She Liu-kwei	Man-tu-lan She	M 5.00 Y 4.01	167.0	M 6,743 Y 5,394	4,800	127.83	do.
14	"	Mang-tu-lan She	To-na She Liu-kwei	M 14.00 Y 10.30	171.0	M 19,473 Y 14,215	3,300	243.98	Run of river type with a diversion weir.
15	"	To-na She	Ling-shan-chiao Hao-shu	M 16.50 Y 12.28	138.50	M 18,588 Y 13,755	9,400	315.53	Run of river type.
16	Li-liao	Lai-po-an She Ping-tung	Ta-la-me-ku She Ping-tung	M 5.00 Y 3.48	279.50	M 11,505 Y 8,054	5,400	151.03	Run of river type with a diversion weir.
17	"	Ta-la-me-ku She	Ta-la-ta-la She Ping-tung	M 6.20 Y 4.47	89.0	M 4,430 Y 3,190	5,400	222.30	Run of river type.
18	"	Ta-la-ta-la She	San-ti-men She Ping-tung	M 18.00 Y 12.43	104.0	M 15,227 Y 9,898	1,550	292.76	Run of river type with a diversion weir.

No.	Name of Creek	Intake at	Tail-race at	Quantity of flow in cms	Effective head in m	Output in kw	Length of conduit in m	Catchment area $_2$ in km	Remarks
19	Ai-liao	Pai-ko-hai-she Chao-chow	Ai-liao Nei-pu	M 19.80 Y 14.00	12.00	M 1,804 Y 1,281	1,700	399.21	Run of river type.

M* = Maximum Y* = Yearly Average M = Monthly Maximum

The proposed water power plant stations covered in the above table are mainly of run of river type. Since the rainfall in the river basin varies greatly in a year, the power output from these plants varies concurrently. For the purpose of increase of power output during dry season, the construction of reservoir is necessary.

Irrigation

The arable area in the Hsia-tan-shui Chi basin can be generally divided into 4 plains geographically, namely, Kao-hsiung Kang-shan plain, Pin-tung Yen-pu plain, Kao-shu plain and Mei-nung plain. A table covering the essential information pertaining to these four plains is prepared below:

Name of Plains	Total Cultivable Area in ha.(1)	Cultivated Area in ha.(2)				Irrigation Situation	Area can be cultivated & under TSC in ha.
		2 crop paddy field	crop paddy field	Dry land	Total		
Kao-hsiung Kang-shan(4)	32,950(3)	12,332	5,502	3,808	21,642	Insufficient	11,308
Ping-tung Yen-pu(5)	36,160	15,337	4,969	2,068	22,374	"	13,786
Kao-shu(5)	5,200	1,083	2,407	1,135	4,625	"	575
Mei-nung(5)	6,920	3,849	593	588	5,030	Just sufficient	1,890
Total	81,230	32,601	13,471	7,599	53,671		27,559

(1) Cultivable areas measured from map (Scale 1:50,000) with a 20% deduction for roads, buildings, river beds etc.

(2) Figures from the Hydraulic Association based upon 1952 record.

(3) Including area under A-kung-tien Reservoir.

(4) Under Kao-hsiung Hydraulic Association.

(5) Under Ping-tung Hydraulic Association.

Kao-hsiung Kang-shan Plain

The Kao-hsiung Kang-shan Plain lies to the west of the lower stretch of Hsia-tan-shui Chi and ends to the south of Erh-tseng-hsing Chi. It is about 15 kms from the east to the west and 42 kms from the south to the north. The total area of this plain is 412 km^2 of which 329.50 km^2

(32,950 ha.) are either cultivated or cultiable. There are a number of large cities such as Kao-hsiung, Kang-shan, Tso-ying, Feng-shan etc.on this plain. It is a comparatively prosperous area on this island.

This plain is quite flat. It is higher at the east at an elevation of about 40 meters above the sea level, and inclines at a slope of 1:200 to 1:400 toward the sea. It is formed with alluvial deposit of Quaternary system. Some marine deposit is found along the sea coast. In general, the soil is fertile and thick. The soil texture of the low layer is usually heavy. Saline soil is found at the coastal areas.

The annual rainfall of the entire plain is 1,500 - 2,000 mm and about 80% of which precipitates in the summer season. As the rainfalls from the typhoons are usually of high intensity and the functions of the existing drains are poor due to too many meanders, a part of the low plain has been frequently troubled by floods. But in the winter, when the weather is dry and windy, crops suffer greatly due to shortage of water. At the present, there are only two main irrigation systems, the Tsao-kung and the A-kung-tien. The former is one of the oldest systems on this island and the latter is one of the newest with water from A-kung-tien Reservoir. Besides these two sources, irrigation in this area also depends upon the water from ponds, springs and under ground.

Uplands at Yen-chao, Ta-she, Nan-tzu, Jen-wu, and Wu-sung in this area are weather depending fields without any irrigation facilities. It is hard to find any new source of water unless some reservoir can be built. In the study made by the Japanese on the improvement of Kao-hsiung Kang-shan plain, five possible reservoirs for irrigation and flood control were mentioned, namely A-kung-tien, Shih-chiu-wan, Shih-lung, Chia-jui-chi and Pei-shih-lin. The A-kung-tien Reservoir was completed after the Restoration. Three dam sites, with the exception of the Shih chiu-wan, were investigated by this survey party. The Shih-chiu-wan site was not considered as a number of warehouses had been built inside the reservoir area.

Ping-tung Yen-pu Plain

This area is located eastward from the left bank of the lower stretch of the Hsia-tan-shui Chi. To the east there are mountains. To the north and south, there are the Li-liao Chi and Lin-pien Chi. The total area of this plain is 452 km^2 which covers 36,160 ha of cultivable land and several large cities. The soils are mainly alluvial deposits of the Quaternary System. There are 8,000 ha of land newly reclaimed from river bed. The thickness of the surface soil layer on top of the newly reclaimed river bed varies greatly. In Ping-tung and Chao-chow areas, silty loam is found which is good for cultivation. The annual rainfall in this area varies from 2,000 mm

to 3,000 mm, of which 80% appears in summer, the rainy period.

The main sources of water supply for irrigation uses are from the Ai-liao, Tung-kang and Lin-pien creeks and the artesian springs especially in Chao-chow and Lin-pien areas. Water from some small creeks is also utilized here and there. Due to the fact that the soil in the area is so sandy in nature, the percolation loss is high and renders a low duty of water averaging only 360 hectares per cms. Due to the same reason, it is impossible to build ponds for storage purposes. On the upstream of the Lin-pien Chi, some underground walls were built under the river bed for the purpose of ground flows.

After the Ai-liao Dike was completed, the flows of the Ai-liao Chi and the Tung-kang Chi were separated from each other and the Ping-tung area was no more troubled by the flood of Ai-liao Chi. The work of diverting the water from the Ai-liao Chi for the improvement of the soil through the detention of the silt in the river water and for irrigation was started in 1940 and an intake is built on the Ai-liao Chi in 1949. This intake is located upstream of Ai-liao Chi at a distance of about 2 km east of San-ti-men. Its maximum capacity is 28.70 cms and its minimum is 4.17 cms. A supplementary intake was also built near a suspension bridge for the diversion of 3.61 cms of spring water. However, since the completion of this supplementary intake the amount of water taken in was always very much lower than the orginally estimated figure. Not only there is not sufficient water supply for the extended irrigation area but the water demand for domestic use of the same area also becomes a problem during dry periods. As a whole, the area of 7,000 hectares under the Ai-liao system is insufficiently irrigated especially during dry years. As to the whole Ping-tung Yen-pu plain, the irrigation for 27,294 hectares is to be improved and in addition, there are 8,283 hectares of land to be developed.

Kao-shu Plain

Kao-shu plain is situated between Lao-nung and Ai-liao creeks and has mountains as its east boundary. It has a total area of 6,500 ha., of which 5,200 hectares are cultivated. Due to the lack of necessary dikes, this area suffers greatly from the floods of both creeks. The soil of this area is sandy loam mixed with stones and gravels. This area is irrigated mainly by the water from Cho-kow Chi with a supplementary supply from Kow-she Chi, the upstream of Wu-lo Chi. The total area irrigated under these two systems is 4,625 hectares of which 1,083 hectares are two crop rice field, 2,407 hectares single rice field and 1,135 hectares miscellaneous crop field. During dry years, the irrigation water is insufficient. There was another intake on Lao-nung Chi which was out of function now due to the objection raised by people on Lao-nung plain at the other side of Lao-nung Chi and the change of river course of the river itself.

Mei-nung Plain

This plain is located between Lao-nung and Nan-tzu-hsien Chi. To the north east of this plain, there are mountains. Mei-nung Chi, one of the main tributaries of Nan-tzu-hsien Chi, flows through the central part of this plain. Out of a total area of 8,600 hectares, three are 6,920 hectares of cultivated land. Soils in this area are either sandy loam or silty loam in nature.

The main source of water supply for irrigation of this area is from the tailrace of the Chu-tzu-men Power Station established since 1909 and some water from Mei-nung Chi was also diverted as supplementary water supply. At present, there are 3,849 hectares of 2-crop paddy field, with dependable water supply 1,181 hectares of rice field with not too dependable water supply, and 1,890 hectares of land without any irrigation.

An-wa-na Reservoir (No. 69)
(See Fig. 228-230)

General Description

The proposed dam site is located 1.50 kilometers northeast of An-wa-na, Kao-hsiung Hsien on the middle part of the upstream of Nan-tzu-hsien Chi.

The total drainage area of Nan-tzu-hsien Chi and its tributaries above Chi-shan is about 626.40 km^2 with a length 99.40 kilometers and an average river bed slope 3.4%. The drainage area above the dam site is 341.10 km^2 with a slope of 1 to 10 at its upstream. The slope is gradually reduced to 1 to 100 after passing Wen-tzu-chih. From Wen-tzu-chih down to the dam site, the river channel becomes wider and some land is cultivated by the aborigines. The river channel becomes a narrow gorge again at the proposed dam site. It is suitable to build a high dam for multiple purposes.

If this project is carried out, 185 hectares of cultivated land will be submerged.

Geology

Sandstones and black shales of Wu-lai Series are found upstream of the catchment and dark gray sandstones and shales of Tai-pei Series are found along the middle stretch. From Chia-hsien down to the dam site, rocks are mainly sandstones, gray shales and conglomerates of Hsin-chu Series. Rocks at the dam site are sandstones of Wu-lai series and are hard and dense.

Hydrology

1. Rainfall

Wen-tzu-chih Rainfall Gauging Station is located upstream of the proposed dam site. Records for 34 years from 1912 to 1945 are available. The annual mean rainfall is 3,386.30 mm and the recorded maximum daily rainfall on August 31, 1940 was 619.4 mm. Chi-shan Rainfall Gaging Station is located downstream of the proposed dam site and records for 42 years from 1904 to 1945 are available.

2. Stream Flow

Downstream of the proposed dam site, there were three stream gauging stations, of which one is existing.

Station	Period when observations were made
Hsiao-lin	October 1938 - September 1940.
Shih-chang-li	November 1938 - December 1941 and 1947 till now.
Shan-shan-lin	June 1910 - July 1929.

3. Flood Estimation

By using "Synthetic Unit Hydrograph Method", the estimated max flood discharge at the dam site is 3,450 cms.

Engineering Features

1. Main dam

Type	Concrete dam
Dam crest elevation	790.00 meters
River bed elevation	710.00 meters
Height of dam	80.00 meters
Crest length	410.00 meters
Volume of concrete	819,500 M^3

2. Reservoir

Drainage area	341.10 km^2
High water level elevation	780.00 meters
Dead water level elevation	760.00 meters
Total storage capacity	120,500,000 M^3
Dead storage capacity	53,250,000 M^3
Effective storage capacity	67,250,000 M^3

3. Spillway

Length	59.00 meters
Head on crest	7.0 meters
Discharge capacity	2,400.00 cms

Benefits

1. Water Power

Using the 2-year runoff records at Hsiao-lin Station as a basis, the rated outflow of this reservoir varies from a minimum of 9.40 cms to a maximum of 14 cms. With an effective head of 80 meters

at the proposed power station at a distance of 1.5 km downstream from the dam site, the generated power varies from 7,400 kw to 11,000 kw.

2. Irrigation

Since the low water flow of the river can be raised from 0.8 cms to 9.40 cms through the regulation of this reservoir, the downstream irrigation situation will be greatly improved.

3. The 7-meter storage capacity above the spillway in the reservoir can reduce the flood peak from 3,450 cms to 2,400 cms.

Transportation Facilities and Construction Materials

There is a highway from Chi-shan through Chia-hsien to Hsiao-lin. However, due to lack of proper maintenance, this road is not in good shape. From Hsiao-lin to the dam site, only a foot path is available. Aggregates for concrete work are available near the dam site.

Chi-nan Reservoir (No. 70)
(See Fig. 231)

General Description

The proposed dam site is located at a distance of 100 meters upstream from Pei-shih Chi bridge, 1,500 meters to the south of Chi-shan, Kao-hsiung Hsien. This reservoir is planned to store water for the irrigation of 500 hectares of the south portion of Chi-shan region.

Pei-shih Chi is a tributary of Nan-tzu-hsien Chi of Hsia-tan-shui Chi system. The drainage area above the proposed dam site is about 2.3 sq km with an average annual rainfall of about 2,500 mm. At the proposed dam site, there is an existing earth dam with a reservoir area of 3 hectares. However, this reservoir has already been silted up.

The 800 hectares south of the Chi-shan region are under the Chi-shan Irrigation System diverting water from the Nan-tzu-hsien Chi. Owing to the fact, that 400 hectares of banana field have been converted into rice field and need irrigation, water disputes have frequently happened.

This reservoir is mainly proposed to solve these problems. Ten hectares of cultivated land and two houses will be submerged if this project is carried out.

Geology

Tertiary grayish green sandy shale is found in the whole drainage basin. Its quality is weak and has been greatly weathered. The direction of the strike of both outcrops is N70°E with 40°-60° dip.

Hydrology

1. Rainfall

There is no rainfall station in the drainage area. Records of Chi-shan Station during 1904-1945 were used as reference by the Reconnaissance Party.

2. Stream Flow

No record is available.

3. Estimated Flood

The estimated maximum flood flow at the proposed dam site is 25.30 cms.

Engineering Features

1.	Dam	
	type	Earth dam
	Dam crest elevation	62.50 meters
	River bed elevation	50.00 meters
	Height of dam	12.50 meters
	Crest length	120.00 meters
	Volume of earth dam	37,000.00 M^3
2.	Reservoir	
	Drainage area	2.30 km^2
	High water level elevation	60.00 meters
	Reservoir area	0.42 km^2
	Total storage capacity	2,100,000 M^3
3.	Spillway	
	Type	Shaft type with a diameter of 1.5 meters
	Head on crest	1.0 meter
	Capacity	25.30 cms

Benefits

The stored water of this reservoir will improve 500 hectares of two-crop paddy field and the water disputes between the upper part of Chi-shan Canal and Shan-lin Hsiang will be settled.

Transportation Facilities and Construction Materials

The dam site can be easily connected to the Chi-shan Kao-hsiung Highway through the construction of 100-meter new road. Earth materials for the dam are available in nearby area.

Chao-yuan-szu Reservoir (No. 71)
(See Fig. 232)

General Description

The proposed dam site is located on Chao-yuan-szu Chi before entering Mei-nung Chi of Hsia-tan-shui Chi. It is northwest of Chao-yuan-szu (Temple). The drain area above the dam site is 4.08 square kilometers.

Geology

Rocks of the whole drainage basin are mainly Tertiary grayish green sandstones, which are medium grained and hard. The strike of the outcrops on both banks is N80°E with dip of 55°-65°.

Two houses and 3 hectares of dry land will be submerged after this reservoir is built.

Hydrology

1. Rainfall: There is no rainfall gaging station in the watershed. This report is based on the records of the Chung-tan Station during 1915-1945.

2. Stream Flow: None.

3. Flood Estimation: The estimated flood flow at the proposed site is 41.00 cms.

Engineering Features

1. Dam

Type	Concrete or rockfill
Dam crest elevation	122.00 meters
River bed elevation	94.00 meters
Height of dam	28.00 meters
Length of dam crest	120.00 meters

2. Reservoir

Drainage area	4.08 km^2
Elevation of high water level	120.00 meters
Reservoir area	0.18 km^2
Total effective storage capacity	2,450,000 M^3
Effective storage capacity	2,450,000 M^3

Benefits

This reservoir will be good to provide irrigation water for 300 hectares downstream of Chao-yuan-szu Chi.

Transportation Facilities of Construction Materials

The rural highway leading to the dam site has to be improved. Aggregates for concrete are available near the dam sites and are fairly good in quality.

Mei-nung Reservoir Layout No. 1 (No. 72)
(See Fig. 233-235)

General Description

The proposed dam site is located at a gorge section downstream from the confluence of the main north and east tributaries of Mei-nung Chi. It is about 2 kilometers to the northeast of Chiu-chiung-lin, Mei-nung Chen, Kao-hsiung Hsien. The drainage area is about 23.00 sq km well covered with forest. The valley at the upstream of the gorge section is quite broad.

The average annual rainfall of the catchment area is about 3,000 mm and the recorded maximum rainfall is about 5,000 mm. Chu-tou-chiao canal intake at the proposed dam site was built by Kao-hsiung Hydraulic Association for the irrigation of 160 hectares at the downstream of Mei-nung Chi. The water of this system is insufficient during dry season.

Geology

The rock at the dam site is Tertiary sandstone intervened with layers of shale and is medium grained and hard in quality. The direction of the strike of the outcrops at the left bank is N10°E with 82° dip toward downstream and it is N80°-90°E with 50°-60° dip toward upstream at the right bank. By observation, there may be a fault parallel with the stream which may be determined by boring tests.

Hydrology

1. Rainfall: Within the catchment, there is no rainfall gauging station. The records of Chung-tan Station during 1915-1945 were used as reference by this report.

2. Stream Flow: None.

3. Flood Estimation: The estimated flood discharge at the dam site is 204 cms.

Engineering Features

1.	Dam	
	Type	Concrete or rockfill
	Dam crest elevation	136.00 meters
	River bed elevation	90.00 meters
	Height of dam	46.00 meters
	Length of crest	300.00 meters
	Estimated volume of dam	619,000 M^3
2.	Reservoir	
	Drainage area	23.00 km^2
	Elevation of high water level	133.00 meters
	Reservoir area	2.20 km^2
	Total or effective storage capacity	45,000,000 M^3
3.	Spillway	
	Length	48.80 meters
	Head	1.20 meters
	Discharge capacity	140.00 cms

Benefits

1. Flood Control

The estimated runoff from the catchment area is 41,400,000 M^3 which can totally be stored in this reservoir. In other words, the flood danger at the downstream can be entirely avoided.

2. Irrigation

As estimated, this reservoir will provide water for 1,290 hectares of two-crop paddy field and 600 hectares of single-crop paddy field. The value of rice produced every year is about NT$13,000,000.

Transportation Facilities and Construction Materials

The dam site can be reached by highway. The gravel and sand available near the dam site are good for concrete work.

Remarks:

(a) As estimated by the Reconnaissance Party, the construction cost of this project including the construction of irrigation system is about NT$36,000,000. If 50% of the benefit from irrigation is counted as the net benefit of this project then the benefit and cost ratio of this project is 1.80.

(b) Mei-nung Chi lies between Nan-tzu-hsien Chi and Lao-nung Chi. Water from Lao-nung Chi can be easily diverted into this reservoir with a tunnel 2.0 kilometers long. Furthermore, as the river bed of Lao-nung river is higher than Mei-nung Chi, an effective head of about 70 meters can be obtained and some power can be developed. This point has to be taken into consideration when a detailed study of this project is made.

Mei-nung Reservoir Layout No. 2 (No. 72)
(See Fig. 233-235)

General Description

This project will use the same dam site as layout No. 1. An arch gravity dam of 114 meters in height will be built. In addition, an earth dam or a rock fill dam, 64 meters in height will be built at a valley to the southeast of the main dam. These two reservoirs will be joined by a tunnel and have a total storage capacity of 326,000,000 M^3. Since the total catchment area of these two reservoirs is only 28.90 sq km and the total runoff can not fill up these two reservoirs, water from Nan-tzu-hsien Chi and Lao-nung Chi is proposed to be diverted into these reservoirs for power development and for irrigation of Mei-nung area. Furthermore any surplus water can be sent back into Nan-tzu-hsien Chi and again stored by the proposed Erh-tseng-hsing Reservoir for the irrigation of Kao-hsiung and Kang-shan plains. The proposed intake on Nan-tzu-hsien Chi is on the left bank of the river opposite the Ta-chiu-yuan Tsun. The drainage area of Nan-tzu-hsien Chi above this proposed intake is 451.70 sq km. The proposed intake on Lao-nung Chi is on the right bank of the river at Chiu-chuang and the drainage area of Lao-nung Chi above Chiu-chuang is 927.90 sq km. As planned, the intake on Nan-tzu-hsien Chi will have a capacity of 11.50 cms and that on Lao-nung Chi will have a capacity of 27.50 cms.

Engineering Features

1. 1st Dam

Type	Concrete arch gravity
Dam crest elevation	204.00 meters
River bed elevation	90.00 meters
Height of dam	114.00 meters
Crest length	680.00 meters
Volume of concrete dam	2,041,000 M^3

2. 2nd Dam

Type	Earth or rock fill
Dam crest elevation	204.00 meters
River bed elevation	140.00 meters
Height of dam	64.00 meters
Crest length	280.00 meters
Earth volume	1,606,000 M^3

3. Reservoir

Total drainage area above both reservoirs	28.90 km^2
Drainage area above Nan-tzu-hsien Intake	451.70 km^2
Drainage area above Lao-nung Intake	927.90 km^2
Total amount of water to be diverted from Nan-tzu-hsien Chi and Lao-nung Chi	39.00 cms
High water level elevation in both reservoirs	200.00 meters
Maximum drawdown	60.00 meters
Total storage capacity	326,000,000 M^3
Effective storage capacity	280,000,000 M^3
Maximum available head	120.00 meters
Regulated flow	33.00 cms

4. Spillway

Length	42.00 meters
Head on crest	1.5 meters
Discharge capacity	255.00 cms

Benefits

1. Water Power

Maximum power	39,600 kw
Firm power	33,000 kw

2. Irrigation

a) Mei-nung Plain

Improvement of irrigated area	5,000 ha
New irrigation	2,000 ha

b) Kao-hsiung and Kang-shan Plain

Improvement of irrigated area	5,000 ha
New irrigation	12,000 ha
Total	24,000 ha

3. Flood Control

This reservoir will store all the flood water from the drainage area.

Pao-lai Reservoir (No. 73)
(See Fig. 236-238)

General Description

The proposed dam site is located at a distance of 1.70 kilometers to the northeast of Yang-tzu-chiao, Liu-kwei Hsiang, Kao-hsiung Hsien. It is on Lao-nung Chi about 4 kilometers upstream from the confluence of Lao-nung Chi and Pao-lai Chi. The drainage area of Lao-nung Chi and its tributaries above Hsin-kai is about 771.30 sq km and the river is 78 kilometers in length with an average slope of about 3.82%.

The catchment area above the dam site is 624.20 sq km. The river has a slope of about 1 to 14 at the upstream and about 1 to 100 nearby Lai-chien. The river valley is in a gorge shape at the proposed dam site.

A different proposal, other than what detailed in this report, was worked out during Japanese Occupation. This Japanese proposal consists of (a) the construction of a dam on Lao-nung Chi at a distance of 400 meters upstream of the confluence of Lao-nung Chi and Pao-lai Chi; (b) the construction of a tunnel 660 meters in length with a capacity of about 15.26 cms to divert water from Pao-lai Chi into the reservoir as a supplementary water supply; (c) the construction of another tunnel 10,500 meters in length with a capacity of 50 cms to divert water from the reservoir to a surge tank to be built at Shih-eh-tou, Liu-kwei Hsiang; and (d) the construction of penstocks and a power-house at the right bank of Lao-nung Chi. This runoff river type power plant will have a maximum capacity of 31,519 kw at a head of 77.50 meters.

Geology

The rock at the proposed dam site is coarse sandstone which is massive and sound, but has many seams. The direction of strike and the dip of the outcrops are not distinctive.

Hydrology

1. Rainfall

Station	Period of Observation	Maximum Daily Rainfall in mm	Average Annual Rainfall in mm	Remarks
Yen-erh	February 1910-September 1945	560.00	2,664.00	Within the catchment
Lao-nung	January 1904-December 1944	508.70	3,063.4	do.

Station	Period of Observation	Maximum Daily Rainfall in mm	Average Annual Rainfall in mm	Remarks
Hsin-wei	January 1904-June 1945	397.00	3,151.90	Within the catchment.
Chia-hsien	January 1904-July 1945	595.00	3,077.90	In adjacent area.
Wen-tzu-chih	January 1912-December 1945	619.40	3,386.30	do.

2. Stream Flow

Station	Period of Observation
Yen-erh	October 1938 - July 1940.
Hsin-kai	September 1920 - October 1941. 1947 - till now.
Mei-piao	September 1925 - December 1926. June 1939 - December 1945.

3. Flood Estimation

As calculated by "Synthetic Unit Hydrograph Method", the maximum flood flow is estimated to be 5,620 cms.

Engineering Features

1. Dam

Type	Concrete
Dam crest elevation	450.00 meters
River bed elevation	420.00 meters
Height of dam	30.00 meters
Crest length	130.00 meters
Volume of concrete	34,000 M^3

2. Reservoir

Drainage area	624.20 km^2
High water level elevation	442.00 meters
Dead water level elevation	430.00 meters
Total storage capacity	7,000,000 M^3
Dead storage capacity	2,000,000 M^3
Effective storage capacity	5,000,000 M^3

3. Spillway

Length	120.00 meters
Head on crest	6.00 meters
Capacity	3,800.00 cms

Benefits

This proposed reservoir has a smaller storage capacity than that proposed by the Japanese. However, it will regulate the flow of the river from 8.40 cms as minimum to 23.00 cms as maximum. If a power station is built nearby the dam site, the power generated will be 7,920 kilowatts and 21,700 kilowatts as the minimum and maximum discharge respectively.

Transportation Facilities and Construction Materials

There is a highway between Chi-shan and Liu-kwei. From Liu-kwei to Shang-lao-nung, the existing highway is rather narrow. Only foot path is available from Shang-lao-nung to the proposed dam site.

Aggregates for concrete work are available near the dam site.

Tu-lung-wan Reservoir (No. 74)
(See Fig. 239-240)

General Description

This proposed dam is also located on Lao-nung Chi about 17 km downstream from the proposed Pao-lai dam site. It is 2 kilometers northeast of Tu-lung-wan, Liu-kwei Hsiang, Lao-hsiung Hsien.

In 1917, a low dam at this place and a power house at Tu-lung-wan for developing water power were built. The intake was located at Chung-tzu-pu, Liu-kwei Hsiang. Under an effective head of 30.6 meters, the maximum output of the power plant was 3,100 kilowatts at a flow of 15.72 cms. The ordinary output was 1,500 kilowatts at a flow of 7.61 cms. The above mentioned dam and intake were washed away by flood. A new intake was built about 1 kilometer upstream from the old one. This intake is still used for power development now.

The catchment area above the proposed dam site is 838.40 sq km and at the dam site, the river bed slope is about 1 to 130. The proposed reservoir is aimed to store water for irrigation and power development and also for the purpose of flood control.

70 houses at Chung-tzu-pu, Shih-eh-tou, Hsin-kai and Lao-nung Tsun, 500 hectares of cultivated land and 12 kilometers of rural highway will be submerged if this project is carried out.

Geology

Rocks at the dam site, are mainly black slates. The direction of the strike of the outcrops at both banks is N88°E with 60° dip toward upstream.

Hydrology

1. Rainfall: Available records on rainfall and stream flow are listed in the report of Pao-lai Reservoir.

2. Flood Estimation: By calculation the maximum flood discharge at the dam site is 6,920 cms.

Engineering Features

1. Dam

Type	Concrete dam
Dam crest elevation	387.00 meters
River bed elevation	280.00 meters
Height of dam	107.00 meters
Dam crest length	480.00 meters
Volume of concrete for the dam	1,038,000.00 M^3

2. Reservoir

Drainage area	838.40 km^2
Elevation of high water level	374.00 meters
Elevation of dead water level	350.00 meters
Total storage capacity	4.35×10^8 M^3
Dead storage capacity	2.00×10^8 M^3
Effective storage capacity	2.35×10^8 M^3

3. Spillway

Length	81.00 meters
Head on crest	10.00 meters
Discharge capacity	5,600.00 cms

Benefits

1. Water power

Using the mass curve, run-off duration and duration area curves of Hsin-kai Station as bases, the rated outflow from the reservoir will be 31 cms as minimum and 46 cms as maximum. The power output of the plant to be built below the dam at an effective head of 82 meters will vary between 24,900 kw to 37,000 kw.

2. Irrigation

After this reservoir is built, the low water flow of Lao-nung Chi will be raised from 8.7 cms to 31 cms. It will solve the water disputes between Kao-hsiung and Chi-shan districts.

3. Flood Control

This reservoir will reduce the flood peak from 6,920 cms to 5,600 cms.

Transportation Facilities and Construction Materials

This dam site can be reached by highway. The black slate near the dam site was used as concrete aggregate by the Power Company to build the low dam. The left over portion of the low dam is still in good shape. However, some tests should be run before a final judgement on using such kind of aggregate for dam construction can be made.

Cho-kow Reservoir (No. 75)
(See Fig. 241-242)

General Description

Cho-kow Chi is one of the main tributaries of Hsia-tan-shui Chi. At Ta-tsin, it meets with Lao-nung Chi. Cho-kow Chi is about 47 km in length with a drainage area of 360.70 sq km. The proposed dam site is on Cho-kow Chi before joining Lao-nung Chi. At the proposed dam site, the river is in a gorge section with an average river bed slope of about 1 to 350. There is a saddle on the left bank of Cho-kow Chi, which can be utilized as a spillway.

Geology

The rocks at the proposed dam site are black slates and black sandy shales which can be easily weathered. The direction of the strike of outcrops on both banks is N75°W with 35° dip.

Hydrology

1. Rainfall

There are five rainfall gaging stations adjacent to the catchment area which are listed below:

Station	Period of Observation	Recorded Maximum Daily Rainfall in mm	Annual Mean Rainfall in mm
Te-wen	January 1912-April 1945	684.70	4,036.50
Hsin-wei	January 1904-June 1945	397.00	3,151.90
Yen-erh	February 1910-September 1945	560.00	2,664.00
Lao-nung	January 1904-December 1944	508.70	3,063.40
Shou	January 1929-January 1945	339.00	1,872.90

2. Stream Flow

Station	Period of Observation
Wei-liao	November 1913 - December 1917 January 1947 to now.
Ta-tsin	May 1940 - December 1942
Ma-ga She	December 1938 - December 1945

3. Flood Estimation

The maximum flood discharge at the proposed dam site is about 4,720 cms which is calculated by using rational formula.

Engineering Features

1. Dam

Type	Concrete
Dam crest elevation	220.00 meters
River bed elevation	160.00 meters
Height of dam	60.00 meters
Crest length	360.00 meters
Volume of concrete	410,000 M^3

2. Reservoir

Drainage area	360.70 km^2
Elevation of high water level	212.00 meters
Elevation of dead water level	190.00 meters
Reservoir water area	3.18 km^2
Total storage capacity	112 x 10^6 M^3
Dead storage capacity	50 x 10^6 M^3
Effective storage capacity	62 x 10^6 M^3

3. Spillway

Length	92.00 meters
Head on crest	6.00 meters
Capacity	3,000 cms

Benefits

1. Water Power

Based on the discharge records of Ta-tsin Station, mass curve, duration and duration area curves were worked out by the reconnaissance party. The reservoir regulated flow will vary between a minimum of 7.30 cms and a maximum of 16.00 cms. With an effective head of 40 meters, the power output will be 3,300 kw as firm power and 7,100 kw as maximum power.

2. Irrigation

Water of Cho-kow Chi is used for irrigation of the lower portion of Kao-shu plain. When water is low during dry season, the shortage of water is rather critical. If this reservoir is built, an area of 5,200 hectares will be sufficiently irrigated and the water dispute between Kao-shu and Mei-nung plain will be settled.

3. Flood Mitigation

As estimated, the flood peak of the Cho-kow Chi will be reduced by 36%.

Transportation Facilities and Construction Materials

Ta-tsin is connected with Ping-tung by rural highway. It is very convenient to reach the proposed dam site. Sand and gravel for concrete work are available near the dam site.

Ai-liao Reservoir (No. 76)
(See Fig. 243-244)

General Description

The proposed dam site is located at the confluence of the north and the south main tributaries of Ai-liao Chi, about 2.50 kilometers to the southeast of San-ti-men, San-ti Hsiang, Ping-tung Hsien. The drainage area above the proposed dam site is 404.00 square kilometers. The river bed slope of the north branch is about 1 to 8 in the upstream and is 1 to 50 in the downstream and that of the south branch is about 1 to 7 in the upstream and 1 to 25 in the downstream. Maps covering the dam site area with a scale of 1 to 2,500 are available in the Provincial Water Conservancy Bureau.

Geology

Slates and hard sandstones are found in the upper part of the drainage area. In the mid-stream, rocks are black shales. Rocks in the lower part of the drainage area are mainly coarse sandstones. At the dam site, rocks are mainly black slates. The direction of the strike of the outcrops on both banks is N10° W with 50° dip toward upstream.

Hydrology

1. Rainfall

Rainfall stations in adjacent regions are listed as below:

Station	Period of Observation	Recorded Maximum Daily Rainfall in mm	Annual Mean Rainfall in mm
Te-wen	January 1912 - April 1945	684.70	4,036.50
A-tui-lu	March 1939 - January 1942	-	-
San-ti-men	August 1940 - January 1942	-	-
Hwa-lo	January 1912 - June 1945	1,127.00	5,441.40

2. Stream Flow

Station	Period of Observation
Ai-liao	July 1926 - September 1931; December 1938 - December 1943.
Pai-ko-hai	November 1924 - September 1926; December 1938 - October 1940; January 1947 - till now.

Engineering Features

1. Dam

Type	Concrete
Dam crest elevation	294.00 meters
River bed elevation	155.00 meters
Height of dam	139.00 meters
Crest length	660.00 meters
Concrete volume	3,200,000 M^3

2. Reservoir

Drainage area	404.00 km^2
Elevation of high water level	280.00 meters
Elevation of dead water level	234.00 meters
Total storage capacity	294 x 10^6 M^3
Dead storage capacity	82 x 10^6 M^3
Effective storage capacity	212 x 10^6 M^2

3. Spillway

Length	59.00 meters
Head on crest	10.00 meters
Capacity	4,120.00 cms

Benefits

1. Water Power

Based upon the runoff records at Pai-ko-hai Station, mass curve, duration and duration area curves have been worked out. Using these curves as bases, the regulated flow will be 18.00 cms

as minimum and 26.50 ~~cms as maximum.~~ ~~With~~ an effective ~~head~~ of 102 meters, the average and the msximum power generated will be 18,000 kw and 26,500 kw respectively.

2. Irrigation

Water released through the power house will be used for the irrigation of 15,400 hectares of Yen-pu and Ping-tung plain.

3. Flood Mitigation

The peak flow of Ai-liao Chi can be reduced by 20%.

Transportation Facilities and Construction Materials

San-ti-men can be reached by highway. From San-ti-men to the dam site, only a foot path is available. Aggregates for concrete work have to be shipped in from outside area.

Liang-shan Reservoir (No. 77)
(See Fig. 245)

General Description

The proposed dam site is located on Tung-kang Chi at Liang-shan Tsun, Ma-chia Hsiang, Ping-tung Hsien. The average width of the creek is about 300 meters. The average slope is 1 to 130. At the proposed dam site, the width is 220 meters. The drainage area above the dam site is 10.50 sq km and during the dry season, there is no flow. To the east of the proposed dam site, it is the foot hill of Mt. Wu-tou of the Central Range and to the west, there is a plateau at an elevation up to 100 meters. The west of the plateau is the Ping-tung plain with a total area of about 15,400 hectares formed by deposits of Ai-liao Chi. The Ping-tung plain has a slope of about 1 to 200 at an elevation between 20-70 meters. Since 1938, after the Ai-liao Dike was completed, the work for the improvement of the soil was underway. The intake on Ai-liao Chi was completed in 1949. As the amount of water diverted from Ai-liao Chi is only about 2.5 cms during dry period and 13 cms during summer period, it is insufficient for the irrigation of 11,800 hectares of Ping-tung plain. This is particularly true in dry winter.

This proposed reservoir is aimed to store Ai-liao Chi water during the high stage and to release it as supplementary supply during the low stage. Some surveying work was done by the PWCB and the topographical maps of the reservoir and the dam site are available.

This reservoir if built will submerge 13 hectares of cultivated land and 10 farm houses.

Geology

At the left side of the proposed dam site, the rock is Tertiary black slate and is hard and dense in quality. While at the right, it is Pleistocene table land gravel. The direction of the strike of the outcrops is N50° - 60° E with dip of 30° - 40° toward downstream.

Hydrology

1. Rainfall: The following records were available when this survey was made:-

Rainfall records at Lao-pi Station (Pineapple Corporation) of 1952 - 1953.

Rainfall records at Ai-liao Station (Ping-tung Hydraulic Association) of 1949 - 1953.

Rainfall records at Chen-hsing Station (Ping-tung Hydraulic Association) of 1938 - 1953.

2. Stream Flow: None.

3. Flood Estimation: The estimated flood discharge at the proposed dam site is 132 cms.

Engineering Features

As proposed, water of Ai-liao Chi during high stage will firstly be diverted into the Ai-liao Irrigation Canal and then led to and stored in the proposed reservoir through a tunnel about 250 meters in length.

1. Main Dam

Type	Earth dam
Dam crest elevation	98.40 meters
River bed elevation	58.60 meters
Height of dam	39.80 meters
Length of crest	350.00 meters
Volume of earthwork	1,450,000 M^3

2. Reservoir

Drainage area	10.50 km^2
High water level elevation	94.40 meters
Reservoir area	150.00 hectares
Total storage capacity	25,900,000 M^3
Effective storage capacity	23,400,000 M^3

Benefits

This reservoir will provide supplementary water to an area of 11,800 hectares in Yen-pu region.

Transportation Facilities and Construction Materials

The dam site is at a distance of 2.5 kilometers from the Ping-tung Li-kang Highway. This 2.5 kilometers road has to be improved.

Soil material for the construction of the dam is available in the area near the dam site.

Nan-shih-hu Reservoir (No. 78)
(See Fig. 246)

General Description

The proposed dam site is located in a gorge section of the Nan-shih-hu Chi of Tung-kang Chi. It is at a distance of about two kilometers to the north of Hsin-chih, Chao-chow Chen, Ping-tung Hsien. The drainage area above the dam site is about 4.8 sq km. The river bed is composed of sand and gravel. As the water in the river disappears so quickly after each storm, the rate of percolation of the river bed might be high. The east tributary above the dam site is adjacent to Lai-she Chi with a hill range in between. Water of Lai-she Chi can be diverted into this reservoir if a tunnel 1,800 meters in length is built.

In the downstream of the Nan-shih-hu Chi, the land is principally weather depending and irrigation is badly needed. Only a portion of this area is insufficiently irrigated by the surplus water from Hsin-chih Farm. Water is diverted from Nan-shih-hu Chi through the construction of a submerged weir.

Geology

The rock within the drainage area is Tertiary black slaty shale which is dense and hard.

Hydrology

1. Rainfall: Rainfall records at the Chih-shan Station for 1904 - 1940 and 1942 - 1944 were used as reference.

2. Stream Flow: None.

3. Flood Estimation: The estimated flood flow at the dam site is 48 cms.

Engineering Features

1. Dam

Type	Earth dam
Dam crest elevation	78.00 meters
River bed elevation	55.00 meters
Height of dam	23.00 meters
Crest length	540.00 meters
Volume of earth dam	509,000 M^3

2.	Reservoir	
	Drainage area	4.80 km^2
	High water level elevation	75.00 meters
	Reservoir area	0.47 hectare
	Total storage capacity	5,000,000 M^3
	Effective storage capacity	5,000,000 M^3
3.	Spillway	
	Type	Chute
	Crest elevation	75.00 meters
	Head on crest	1.00 meter
	Capacity	48.00 cms

Benefits

The reservoir will provide water for the irrigation of over 500 hectares.

Transportation Facilities and Construction Materials

The road from the dam site to the Ping-tung Hsin-chih Farm Highway has to be improved. Earth material for dam construction is available in nearby region.

Lai-she Reservoir (No. 79)
(See Fig. 247-248)

General Description

The proposed dam site is located at the confluence of Lai-she Chi and Wa-lu-szu Chi, two tributaries of Lin-pien Chi. It is at a distance about 3 kilometers to the east of Hsin-chih Farm, Lai-she Hsiang, Ping-tung.

Since Japanese Occupation, a submerged dam has been built to intercept ground flow to irrigate Hsin-chih and Hsin-tso districts. However, the water so intercepted can not meet the overall demand. This reservoir is proposed to solve the water shortage problem.

Geology

The rock above the confluence of the tributaries is Tertiary dark gray sandy shale and is hard in nature but will crumble after weathered. At the dam site, the rock has the same nature and some sliding can be found as the slope is steep.

Hydrology

1. Rainfall: There were seven rainfall stations in and around the catchment area.

Station	Period of Observation	Mean Annual Rainfall in mm	Maximum Daily Rainfall in mm
Lai-she	July 1934 - February 1945	4,911.10	640.90
Hwa-lo	January 1912 - June 1945	5,441.40	1,127.00
Chi-shan	January 1904 - April 1945	2,506.80	366.00
Mung-chia-li	January 1912 - March 1945	3,874.90	1,125.00
Chin-shui-ying	January 1912 - June 1939	5,087.50	693.30
Chin-Huang	January 1912 - August 1945	2,619.70	500.20
Chiai-ta	January 1912 - January 1945	2,536.40	641.50

2. Stream Flow

Hsin-chih Gauging Station was established in 1940 by the Japanese and observations were made during 1940 - 1942. Records of 1940 - 1942 are available.

3. Flood Estimation

The cauculated flood discharge at the proposed dam site is 7,760 cms.

Engineering Features

1. Dam

Type	Concrete dam
Dam crest elevation	168.00 meters
River bed elevation	90.00 meters
Height of dam	79.00 meters
Crest length	550 meters
Volume of the concrete dam	600,000 M^3

2. Reservoir

Drainage area	121.00 km^2
Reservoir area	3.90 km^2
High water level elevation	155.00 meters
Dead water level elevation	121.00 meters
Total storage capacity	117,500,000 M^3
Dead storage capacity	39,740,000 M^3
Effective storage capacity	77,760,000 M^3

3. Spillway

Length	80.00 meters
Head on crest	10.00 meters
Capacity	5,500 cms

Benefits

1. Water Power

Based upon the 1940 - 1942 records of Hsin-chih Station, inflow mass curve, duration curve and duration area curve were prepared by the party. Based on these curves the regulated outflow of this

reservoir will be 10.00 cms and 13.50 cms as minimum and maximum respectively. With an effective head of 48 meters, the generated power will be 4,700 kw as firm power and 6,500 kw as maximum power.

2. Irrigation

The tailrace water of the power station will be utilized for the irrigation of Wan-lung and Hsin-pi area in the downstream of Lin-pien Chi.

3. Flood Mitigation

This reservoir will reduce the flood peak by 27.6%.

Transportation Facilities and Construction Materials

Hsin-chih is connected with Chao-chow by a rural highway. From Hsin-chih to the dam site, only a foot path for 3.5 kilometers is available at present. The aggregates available at the dam site should be analyzed before adopted for concrete work.

Li-ly Reservoir (No. 80)
(See Fig. 249-250)

General Description

This proposed dam site is located on Li-ly Chi, a branch of Lin-pien Chi. Li-ly Chi before entering into the flat land has a very narrow section at which a dam can be built. The drainage area of Li-ly Chi including its tributaries is approximately 112 km^2. In 1923, a submerged dam was built by the Japanese at this site under Ta-hsiang-ying Underground Water Development Project for the irrigation of 1,500 hectares of sugar cane.

This submerged dam is 145.4 meters in length and is 8 meters under the river bed. The collecting gallery at the right bank of the river is 454.50 meters in length with a semi-circular section. It was proposed by the Japanese that 0.68 cms of water can be obtained during dry period and 4.25 cms during wet period. However the present amount of water during dry period is only 0.33 cms. Some studies are made by Ta-hsiang-ying Farm of T.S.C.* for the purpose of getting more water.

Geology

The rock at both sides of the proposed site is black sandy shale, which is hard and dense. The direction of the strike of the outcrops is N20°E with 75° dip toward upstream.

Rock in the river basin is mainly slate which can be easily weathered. Land slides are found every where. The over burden at the proposed site is estimated to be 30 meters in depth.

Hydrology

1. Rainfall

There was a rainfall station (Chin-shui-ying) in the catchment basin above the proposed dam site. Observation records during 1912 - 1939 are available. From these available records, the annual mean rainfall is 5,087.50 mm and the maximum daily rainfall is 693.30 mm. The following 4 stations are adjacent to the Li-ly proposed site.

* Taiwan Sugar Corporation

Station	Period of Observation
Mung-chia-li (Bongan)	January 1912-March 1945
Lai-she	July 1934-February 1945
Chin-huang	January 1913-August 1945
Ta-wu	October 1903-January 1945

As calculated by Thiessen's method, the maximum daily rainfall of the catchment area above the dam site is 778.80 mm.

2. Stream Flow

A stream gauging station was established at Ta-hsiang-ying and records of 1940-1942 are available.

3. Flood Flow

The estimated flood flow at the dam site is 6,300 cms.

Engineering Features

1. Dam

Type	Concrete
Dam crest elevation	198.00 meters
River bed elevation	100.00 meters
Height of dam	98.00 meters
Crest length	500.00 meters
Volume of concrete dam	1,150,000 M^3

2. Reservoir

Drainage area	112.00 km^2
High water elevation	185.00 meters
Dead water elevation	158.00 meters
Reservoir area	274 hectares
Total storage capacity	104,000,000 M^3
Effective storage capacity	57,100,000 M^3

3. Spillway

Length	58.50 meters
Head on crest	9.89 meters
Capacity	4,000 cms

Benefits

1. Water Power

Based on the flow duration and duration area curves of Ta-hsiang-ying Station, the regulated flow from the reservoir will be 10 cms as minimum and 13.6 cms as maximum.

For an effective head of 52.50 meters, the firm power output of a water power plant will be 5,150 kw and the maximum power output will be 7,000 kw.

2. Irrigation

The tailrace water of the proposed power plant can be utilized for the irrigation of 8,000 hectares at Shui-ti-liao.

3. Flood Control

The flood water level in the reservoir is proposed to be at an elevation of 198 meters. As estimated, the peak flow of the river will be reduced by 39%.

Transportation Facilities and Construction Materials

Shih-tou-ying Tsun is connected with Ping-tung Heng-chun Highway by a rural highway 3.5 kilometers in length. The proposed dam site is at a distance of 4.5 kilometers to the east of Shih-tou-ying, and there is only a foot path available. Aggregates are available near the dam site.

Szu-chung-chi Reservoir (No. 81)
(See Fig. 251-253)

General Description

The proposed dam site is located on Szu-chung Chi at Stone Gate, about 2.50 kilometers to the northeast of Wen-chuan Tsun, Chi-cheng Hsiang, Ping-tung Hsien. The river above the dam site is 22.4 kilometers in length with a slope of 1 to 80. The river slope at the dam site is 1 to 200. As the river runs mainly in hard rock mountain, the water is quite clear. The survey work of this project was carried out by PWCB*in 1952. Five kilometers of rural highway will be submerged if this project is carried out.

Geology

Rocks are mainly sandstones or shales. At the dam site, some conglomerates are found. The weathering problem at this site is negligible. Geologically speaking, this site is supposed to be the best on this island.

Hydrology

1. Rainfall: Rainfall records during 1916 - 1945 at Mu-tan She are available.

2. Stream Flow: Discharge records during 1940 - 1942 at Stone Gate are available.

3. Flood Estimation: As calculated by rational method, the maximum discharge is about 2,100 cms.

Engineering Features

1. Dam

	Layout 1	Layout 2
Type	Concrete arch	Concrete gravity
Dam crest elevation	95.00 meters	140.00 meters
River bed elevation	55.00 meters	55.00 meters
Height of dam	40.00 meters	85.00 meters
Crest length	100.00 meters	210.00 meters

* Provincial Water Conservancy Bureau

2. Reservoir

	Layout 1	Layout 2
Drainage area	90.80 km^2	90.80 km^2
High water level elevation	92.00 meters	135.00 meters
Reservoir area	1.55 km^2	5.00 km^2
Total storage capacity	21.3x10^6 M^3	166.2x10^6 M^3
Effective storage capacity	20.0x10^6 M^3	104.2x10^6 M^3

3. Spillway

Type	Morning glory hole (shaft)
Capacity	1,050 cms

Benefits

	Layout 1	Layout 2
1. Irrigation	To irrigate 2,297 ha at Che-cheng and Heng-chun.	Same as Layout 1.
2. Water Supply	To provide water supply for 12,000 persons in Che-cheng, Szu-chung-chi and Heng - chun.	Same as Layout 1.
3. Water Power	20 kw can be generated.	Produce 3,170 kw of firm power and 6,160 kw of maximum power at a discharge of 7 cms and a maximum discharge of 13.00 cms respectively.

Transportation Facilities and Construction Materials

This proposed site is connected with the main highway by a rural highway at Che-cheng.

Sand and gravel are plentiful at the dam site, which can be used for concrete aggregates.

General Descriptions on River Basins in East Taiwan

I. Lu-chia Chi

Lu-chia Chi, also named Ta-nan Chi, is a small river in Tai-tung Hsien. It originates from Mt. Chih-pen with a headwater at an elevation of about 2,000 meters above the sea level. The total length of the river is about 31.5 kilometers with an average slope of 1 to 70. It has a drainage area of 182 km^2.

At the downstream of Lu-chia Chi, some lands are insufficiently irrigated by the Li-chia Canal. If this canal is improved, a total of 450 hectares can be irrigated. At the upstream of Lu-chia Chi at Ta-nan Tsun, there is an existing power station which is called Ta-nan Power Station with an installation capacity of 360 kilowatts. There is another power station at the upstream of Tai-pa-liu-chiu Chi with an installation of 200 kilowatts. This station is not far from the Ta-nan Station. A proposed power station is called Ta-nan No. 2 Station with a proposed capacity of 2,300 kilowatts.

II. Pei-nan-ta Chi

Pei-nan-ta Chi is the largest river in Tai-tung Hsien. It originates from the east side of the Central Range and flows southward. It has three main tributaries, namely Hsin-wu-lu Chi, Lu-liao Chi and Pei-szu-chiu Chi. After these three tributaries joint at Pai-a-pai, the river is called Pei-nan-ta Chi and has a total drainage area of 1,586 km^2. It is 82 kilometers in length with an average slope of 1 to 30. For the lower stretch, the slope is flatter and is about 1 to 160. The drainage area of the three main tributaries is only 1,200 square kilometers and is densely covered with forest. Although the slope of the tributaries is steep, they have clear water nearly year round. In this river basin, there are 4 proposed or partly finished irrigation projects; namely Chih-shang, Kwan-shan, Lu-yeh and Pei-nan. After the completion of these 4 projects, 10,081 hectares will be provided with irrigation. At Kwan-shan, there is an existing power station with a capacity of 35 kilowatts only. A new power station can be built on the proposed Pei-nan Canal with a firm capacity of 6,300 kilowatts and an installation capacity of 9,000 kilowatts. Other 10 water power projects with a total installation capacity of 123,800 kilowatts were proposed by Japanese engineers. However, not much information is available on the Japanese proposed projects and by the judgement of the Party, they are not economical either.

III. Ma-wu-ku Chi

Ma-wu-ku Chi is a small river in Tai-tung Hsien. It originates from the Sea Shore Range with the headwater at an elevation of 500 meters above the sea level. Two tributaries, one from the south and the other from the north, meet near Kao-yuan Tsun. Beginning from there, the river flows eastward in a gorge section and enters into Pacific Ocean. It has a total drainage area of 151 square kilometers with an annual rainfall of about 2,600 mm. The average river bed slope is 1 to 170. There are 404 hectares of irrigated land in this river basin, of which 104 hectares are below the gorge section.

At Kao-yuan, a high dam mainly for power development is proposed and will be detailed under Kao-yuan Reservoir as one of the separate projects in this report.

IV. Hsiu-ku-luan Chi

Hsiu-ku-luan Chi is one of the important rivers in the East Taiwan. It has a total drainage area of 1,800 square kilometers which lies mainly between the Central and the Sea Shore Range. It has six main tributaries, namely; Ching-shui Chi, La-ku-la-ku Chi, Cho Chi, Tai-ping Chi, Hung-yeh Chi, and Ma-lan-tiao Chi. All have densely forest-covered watershed. Rocks in the watershed are slates, shales and sandstones. Of the total drainage area, about 1,170 hectares are covered with forest. The average annual rainfall of the whole basin is 2,100 mm with a maximum of 4,000 mm at the upstream and 1,800 mm at the downstream.

In this basin, there is no power station. There are a number of irrigation canals in this basin covering a total irrigated area of 4,578 hectares. If a proposed canal named Jui-sui Irrigation Canal, is built, an additional area of 2,047 hectares will be covered by irrigation. A water power plant with an installation capacity of 3,250 kilowatts can be put up under the same project as the gross head available in this proposed canal will be 65 meters. The annual firm energy output is estimated to be about 28 million kwh. In this basin, 9 water power plants were proposed by the Japanese with a total installation capacity of 250,300 kilowatts. As information is insufficient, it will not be detailed in this report.

Two reservoir sites, the San-tai site and the Hsiu-ku-luan site, were found by the Reconnaissance Party. They are detailed as separate projects.

V. Mao-kung Chi (Pa-li-wan Chi)

Mao-kung Chi is a very small river entering Pacific Ocean at the north of Hsiu-ku-luan Chi. It originates from Mt. Mao-kung-fu-shih

with the headwater at an elevation of about 350 meters above sea level. The total length of the river is about 13 kilometers with an average slope of 1:40. The total drainage area of the river is about 50 sq km.

In this river basin, there are about 100 hectares of irrigated land and no other new irrigation can be developed.

VI. Hwa-lien Chi

Hwa-lien Chi is an important river in Hwa-lien Hsien. It is located between the Central and the Sea Shore Range in Central Tai-wan. It has four main tributaries, namely: Ma-tai-an Chi, Wan-li-chiao Chi, Chih-ya-kan Chi and Mu-kua Chi. The total drainage area of Hwa-lien Chi is about 1,501 km^2 of which 71% is covered with forest. The length of the main river is about 56 kilometers.

The average annual rainfall is 2,220 mm varying from 4,000 mm as a maximum in the upstream to 1,093 mm as a minimum in the downstream.

There are many irrigation canals in this basin covering a total irrigation area of 6,092 hectares. Under the Chi-an extension program, 1,703 hectares will be further irrigated. Furthermore, along the downstream of the 4-tributaries, there are 6,000 hectares of land to be reclaimed.

There were five hydroelectric plants with a total installation capacity of 39,570 kilowatts in this basin, namely: Chi-kow, Tung-men, Chu-ying, Ching-shui No. 1 and Ching-shui No. 2. Of which Tung-men and Ching-shui No. 2 station were buried by silt of Mu-kua Chi. The capacity of the remaining plants is only 10,570 kilowatts.

Three dam sites were suggested by the Party. These are Fu-tien, Li-yu-chih and Lung-chien and will be detailed as separate projects.

VII. Sha-po-tang Chi

Sha-po-tang Chi, also called Mi-lun Chi, is a very small river north of Hwa-lien Chi in Hwa-lien Hsien. It originates from Mt. Chi-chiao-chuan at an elevation of 2,376 meters above the sea. The length of the river is about 18 kilometers. It has a drainage area of 68 square kilometers.

There are 250 hectares of irrigated land at the downstream of the river. Two power plants with a total installation capacity of 600 kilowatts were built by the Japanese but were covered up by silt.

VIII. San-chan Chi

San-chan Chi is also a small river in Hwa-lien Hsien. It originates from Mt. Chi-chiao-chuan and Mt. Pa-to-lu at an elevation of about 2,000 meters above the sea. The length of the river is about 121 km.

In this area, there is an irrigation project, the Pei-pu Canal, which irrigates 827 hectares of land. Two power projects with a total capacity of 10,000 kilowatts were proposed by the Japanese, but their economical value is questionable.

IX. Li-wu Chi

Li-wu Chi, also named Ta-ke-li Chi, is a relatively large river in Hsin-cheng District of Hwa-lien Hsien. It originates from Mt. Ho-huan with the headwater at an elevation of 2,730 meters above the sea and flows principally eastward. The length of the river is about 49 kilometers with an average slope of 1 to 10. The total drainage area is about 597 square kilometers.

There are only 40 hectares of irrigated land in Hsin-cheng District. If the proposed Hsin-cheng Irrigation Project is built, a new area of 550 hectares will be irrigated.

The existing Li-wu Power Plant with a total installation capacity of 30,200 kilowatts is the largest on the east coast. It was built by the Japanese, but was repaired by the Chinese after being damaged by an unusual flood.

At the upper stream of Li-wu Chi, 5 more power projects with total capacity of 142,500 kilowatts were proposed by the Japanese; however none has been built.

X. Ta-cho-shui Chi

Ta-cho-shui Chi is another relatively large river on the east coast. It is located between Hwa-lien Hsien and I-lan Hsien and flows eastward. It originates from Mt. Nan-hu-ta with the headwater at 2,880 meters above the sea. The total length of the river is 50 kilometers with a total drainage area of 555 square kilometers.

Six power plants with a total installation capacity of 123,000 kilowatts were proposed by the Japanese engineers. In addition, three reservoir sites were selected. However, all the proposed dam sites are no more suitable after being washed by part floods. It seems not economical to develop power in this region as the costs for transmission and maintenance will be high.

XI. Ta-nan-ao Chi

Ta-nan-ao Chi is a small river in I-lan Hsien. It originates from Mt. San-hsing with the headwater at an elevation of about 1,300 meters above the sea and flows in a southeast direction. The river has a total drainage area of 131 square kilometers and has a total length of 35 kilometers. The whole basin is densely covered with forest and has plentiful rainfall. The average annual rainfall at Shan-chiao Rainfall Station is 5,304 mm.

There are a number of small irrigation canals in this basin. Four power plants with a total capacity of 49,000 kilowatts were proposed by the Japanese engineers. The development plan covers (a) the construction of a 61.5-meter dam on the north branch to provide water for 3 consecutive power plants with a total capacity of 42,000 kilowatts and (b) the construction of another dam on the south branch for another power station with a capacity of 7,000 kilowatts. At present, only one power station is under consideration which is 40,000 kilowatts in capacity.

XII. Wu-lao-keng Chi

Wu-lao-keng Chi is another small river in I-lan Hsien. It originates from Mt. Ta-pai with the headwater at an elevation of about 500 meters above the sea. The total length of the river is about 20 kilometers with an average slope of 1 to 40. The total drainage area is about 41 square kilometers with an annual rainfall of 3,000 mm. To the west of Wu-lao-keng Tsun, the river flows in mountains and to the east of the village and below a railway bridge, the river flows in a flat and wide plain which is cultivated. The lower stretch river slope is 1 to 250.

There are 9 irrigation canals in this basin covering a total area of 2,068 hectares. The local people also dig wells to get ground water for irrigation.

XIII. I-lan-cho-shui Chi

I-lan-cho-shui Chi is the most important river in northeast Tai-wan. It originates from the north side of Mt. Nan-hu-ta of the Central Range with the headwater at an elevation of about 1,800 meters above the sea. It flows generally in a north eastern direction and at Po-pu-wu, the river flows from the mountains into I-lan plain. It has a total drainage area of 1,005 square kilometers. The length of the main river is 68 kilometers with a slope of 1 to 100. The annual precipitation of this river basin is about 3,100 mm. The maximum daily rainfall occurred on October 30, 1915 at Tien-sung-pi Station was 959.7 mm.

There are more than 100 canal systems in this basin, covering a total irrigated area of 19,100 hectares. The main problems of most irrigated area are (a) water is frequently insufficient during dry season and (b) water in most years is too much during rainy season and causes damages.

In this basin, there are two hydropower stations. One is the Yuan-shan Power Plant with an installation capacity of 16,300 kw which is one of the important secondary hydro-power stations in the Tai-wan Power System. The other one is the Tien-sung-pi power plant with an installation capacity of 8,600 kilowatts. The latter is the oldest power plant in Tai-wan. As the headwater of this river is at an elevation of 1,800 meters above sea level, the river slope is rather steep, and the watershed is deeply covered with forest and has plentiful rainfall. This river is ideal for development of water power. As proposed by the Japanese engineer, five run-of-river power projects can be built with a total installation capacity of 52,800 kw of which 17,500 kilometers will e primary power.

Four dam sites were found by the party of which three are detailed in this report as separate projects. The names of the reservoirs are Tu-chang, Yuan-shan and Shuang-lien-pi.

XIV. Shuang Chi

Shuang Chi is a very small river in northeast Tai-wan. It originates from the mountains and flows eastward with the headwater at an elevation of 200 meters above the sea. The total drainage area of the river is about 145 square kilometers and the length of the river is 26 kilometers. In this basin, there are seven irrigation systems of which 3 covering 103 hectares are supplied from Shuang Chi.

XV. Huang Chi

Huang Chi is a small river at the north tip of Tai-wan. It originates from Mt. Chi-hsing with the headwater at an elevation of about 500 meters above the sea. The total length of the river is 16 kilometers. It has a total drainage area of 56 square kilometers.

The irrigated area in this basin is about 220 hectares of which 50% is irrigated by water from Huang Chi and the other 50% is irrigated by spring water. The water of Huang Chi is sulphurous in nature.

Proposed Reservoir Projects in East Tai-wan

Kao-yuan Reservoir (No. 82)

General Description

The proposed dam site is located on the lower stretch of Ma-wu-ku Chi near Kao-yuan Tsun. The drainage area above the dam site is 120 square kilometers with an average annual rainfall of 2,600 mm. The proposed dam is 105 meters in height and the reservoir will have a total capacity of 925,000,000 M^3. The effective storage of the proposed reservoir for a drawdown of 60 meters is 800,000,000 M^3. Since this storage capacity is 3 to 4 times higher than the annual run-off of the river, it is planned to divert and to store the water from Hsin-wu-lu Chi and Lu-liao Chi which are two main tributaries of Pei-nan-ta Chi. The valley has a V-shape cross section at the dam site. The river bed at the dam site has a slope of 1 to 100 and is composed of sand and gravel.

If this dam is built, 2 villages and 1,709 hectares of land will be submerged.

Geology

The rock at the dam site is sandstone with small crevices.

Hydrology

There is no record available.

Engineering Features

1. Dam

Type	Concrete arch
Height	105 meters
Top width	10 meters
Base width	80 meters
Top length	120 meters
Concrete volume	190,000 M^3

2. Reservoir

Drainage area of Ma-wu-ku Chi only	120 sq km
Drainage area of Hsin-wu-lu Chi and Lu-liao Chi	925 sq km
Reservoir area	21 sq km
Maximum drawdown	60 meters
Total storage capacity	925×10^6 M^3
Effective storage capacity	800×10^6 M^3

3. Spillway

Elevation of crest above sea level	160 meters
Length	80 meters
Design capacity	1.000 cms

4. Power Plant

Total head available	150 meters
Average flow	37 cms
Minimum flow	30 cms
Installation capacity	80,000 kw
Average capacity	40,000 kw
Firm capacity	30,000 kw
Average annual output	350×10^6 kwh
Firm annual output	253×10^6 kwh

Estimated Construction Cost

Dam	NT$80 x 10^6
Diversion tunnel	60 x 10^6
Power plant	10 x 10^6
Total	NT$150 x 10^6

Benefit

The benefit of this reservoir is limited to power development only.

Transportation Facilities

The highway from Tai-tung to the proposed dam site is in good condition. Some modification work is necessary at station 19 K.

San-tai Reservoir (No.83)

General Description

The proposed dam is located on Pieh Chi, a tributary of Hsiu-ku-luan Chi. As the low water flow has been utilized by two existing irrigation canals, this reservoir is planned to store storm water for the irrigation of additional 200 hectares at the San-tai Tsun in Hwa-lien Hsien. The area to be irrigated is at an elevation of 260 meters to 300 meters above the sea with an average slope of 1 to 30.

The proposed dam site has a V-shape cross section. The river has a slope of 1 to 50 with a sand and gravel bottom.

Geology

The rock at the dam site is sandstone.

Hydrology

No information is available.

Engineering Features

1. Dam

	Layout 1	Layout 2
Type	Concrete Gravity	Earth
Height	7.5 meters	7.5 meters
Length	45 meters	45 meters
Top width	2 meters	3 meters
Base width	6 meters	64 meters
Volume of dam	1,000 M^3	10,500 M^3

2. Reservoir

Drainage area	31 km^2
Reservoir area	17.5 hectares
Maximum drawdown	7.5 meters
Total and effective storage capacity	700,000 M^3

3. Spillway

Elevation of crest above sea level	307.5 meters
Length	45 meters
Capacity	300 cms

4. Canal

Length	2.8 km
Tunnel	75 meters

Cost

As estimated by the local irrigation association, the total cost of this project is NT$1,500,000.

Transportation Facilities

From Chih-shang Railway Station to the dam site, there is only foot path available.

Hsiu-ku-luan Reservoir (No. 84)

General Description

The proposed dam site is located on the lower gorge stretch of the Hsiu-ku-luan Chi. The drainage area above the dam is 1,774 sq km and the river bed slope at the dam site is about 1 to 400. Only fine sand is found along the river.

If this project is built, 4 villages and 250 hectares of land will be submerged.

Geology

The rock at the dam site is slate.

Hydrology

Runoff records for 3 years at Jui-sui Gaging Station are available.

Engineering Features

1. Dam

	Layout 1	Layout 2	Layout 3
Type	Concrete gravity	Concrete gravity	Concrete gravity
Height	57 meters	65 meters	135 meters
Top width	5 meters	5 meters	12 meters
Base width	52 meters	52 meters	105 meters
Top length	200 meters	265 meters	430 meters
Concrete volume	264,000 M^3	216,000 M^3	1,560,000 M^3

2. Reservoir

	Layout 1	Layout 2	Layout 3
Drainage area	1,774 km^2	1,774 km^2	1,774 km^2
Reservoir area	7.58 km^2	9.1 km^2	187 km^2
Maximum drawdown	30 meters	30 meters	70 meters
Total storage capacity	$237 \times 10^6 M^3$	$237 \times 10^6 M^3$	$10,100 \times 10^6 M^3$
Effective storage capacity	$200 \times 10^6 M^3$	$200 \times 10^6 M^3$	$8,800 \times 10^6 M^3$

3. Spillway

	Layout 1	Layout 2	Layout 3
Elevation of crest	70 meters	70 meters	180 meters
Length	150 meters	220 meters	200 meters
Capacity	11,000 cms	11,000 cms	11,000 cms

4. Diversion Tunnel

Length	1,000 meters	-	-
Diameter	6 meters	-	-

5. Power Plant

Maximum head	62 meters	70 meters	135 meters
Maximum flow	90 cms	90 cms	150 cms
Average flow	73.5 cms	73.5 cms	90 cms
Total installation capacity	46,000 kw	50,000 kw	100,000 kw
Average capacity	32,000 kw	35,000 kw	60,000 kw
Annual output	282×10^6 kwh	320×10^6 kwh	500×10^6 kwh

Estimated Construction Cost

	Layout 1	Layout 2	Layout 3
Dam	NT$122x10^6	NT$100x10^6	NT$700x10^6
Diversion tunnel	20×10^6	10×10^6	10×10^6
Power Plant	45×10^6	50×10^6	100×10^6
Total	187×10^6	160×10^6	810×10^6

Benefits

Power benefits are detailed under "Engineering Features".

Transportation Facilities

This proposed dam site can be reached by highway from Tai-tung and can also be reached on foot from Jui-sui along the river.

Fu-tien Reservoir (No. 85)

General Description

The proposed dam site is located on Fu-tien Chi, a small tributary of Hwa-lien Chi, about 3 kilometers to the east of Fu-tien Tsun. This proposed reservoir has a total drainage area of 600 hectares. It is proposed to store water for the irrigation of 500 hectares of the Fu-tien District. As the watershed is covered with forest, the water of the creek is usually clear. The soil of the area to be irrigated is clayey in nature and is rather impervious. The elevation of this area to be irrigated is about 250 meters above the sea level.

At a lower elevation on the same creek, there are two existing reservoirs built by the Japanese with a total capacity of about 256,000 M^3.

Geology

At the proposed dam site, the river channel has a V-shape cross section composed of sand and clay.

Hydrology

No information is available.

Engineering Features

1.	Dam	
	Type	Earth fill
	Height	15 meters
	Top width	4 meters
	Base width	94 meters
	Top length	150 meters
	Total volume of the dam	46,000 M^3
2.	Reservoir	
	Drainage area	6 km^2
	Reservoir area	16 hectares
	Maximum drawdown	14 meters
	Total storage capacity	1,052,000 M^3
	Effective storage capacity	1,000,000 M^3

3. Spillway

Type	Shaft type
Capacity	50 cms

4. Irrigation Channel

Length	5 km
Capacity	0.3 cms

Estimated Cost

Dam	NT$450,000
Waterway	300,000
Structures	230,000
Land	20,000
Total	NT$1,000,000

Benefit

The area to be irrigated by water from this reservoir will be 500 hectares.

Transportation Facilities

The proposed dam site can only be reached on foot from Kwang-fu.

Li-yu-chih Reservoir (No. 86)

General Description

Li-yu-chih is a natural lake situated between Mt. Mu-kua and Mt. Li-yu. It has a water surface of 1.2 sq km at an elevation of 138 meters above sea level. The drainage area of Li-yu-chih is very small. If two earth dams were built at the low places around the lake to store the water from Lao Chi and Ching-shui Power Plant No. 2, more water power could be developed and, at the same time, more land could be irrigated.

Geology

No rock is found at the dam sites.

Engineering Features

1. Dams

	Dam No. 1	Dam No. 2	
		Layout No. 1	Layout No. 2
Type	Earth	Earth	Earth
Height	42 meters	40 meters	44 meters
Top-width	10 meters	10 meters	10 meters
Base width	260 meters	245 meters	280 meters
Top length	600 meters	600 meters	500 meters
Volume of earth	2,200,000 M^3	1,400,000 M^3	2,500,000 M^3

2. Reservoir

	With dam No. 2 at Layout No. 1	With dam No. 2 at Layout No. 2
Reservoir area	1.85 km^2	3.0 km^2
Maximum drawdown	50 meters	50 meters
Total storage capacity	78×10^6 M^3	130×10^6 M^3
Effective storage capacity	73×10^6 M^3	120×10^6 M^3

3. Spillway

	With dam No. 2 at Layout No. 1	With dam No. 2 at Layout No. 2
Crest elevation	180 meters	180 meters
Capacity	100 cms	300 cms

4. Diversion tunnel

Length	6 km	4 km

5. Power Plant

Maximum head	130 meters	130 meters
Maximum flow	40 cms	40 cms
Minimum regulated flow	7 cms	10 cms
Total installation capacity	15,000 kw	20,000 kw
Firm capacity	5,000 kw	7,000 kw
Firm energy annual output	43.8×10^6 kwh	60×10^6 kwh

Estimated Costs

	With dam No. 2 at Layout No. 1	With dam No. 2 at Layout No. 2
Dams	20×10^6	26×10^6
Diversion tunnel	12×10^6	8×10^6
Power Plant	15×10^6	20×10^6
Total	47×10^6	54×10^6

Benefits

1. Flood Control

Since the dam of Layout No. 2 will be built across Lao Chi, this reservoir may provide some protection against flood to the farmers at Shou-feng.

2. Irrigation

1,500 hectares of cultivated land between Lao Chi and Mu-kua Chi will be irrigated by the water from this reservoir.

3. Water Power

As detailed under "Engineering Features".

Transportation Facilities

The proposed dam site can be reached by highway. However, a bridge has to be built on Mu-kua Chi.

Lung-chien Reservoir (No. 87)

General Description

The proposed dam site is located on Mu-kua Chi near Lung-chien Tsun. It is about 3 km upstream from Tung-men Intake. One of the two proposals is to build a dam 190 meters high to create a reservoir with a total storage capacity of 146 x 10^6 M^3. The other proposal is to build a dam with a height of 100 meters at an upper site. The reservoir so created will have an effective storage capacity of 61.6 x 10^6 M^3 within a drawdown range of 20 meters.

Geology

The valley is of V-shape. The rock at both sites is granite and is good for high dam construction. As the famous Tien-chang Cliff is upstream from the proposed sites, the silt problem of this proposed reservoir is rather serious and should be seriously considered.

Engineering Features

1. Dam

	Layout No. 1	Layout No. 2
Type	Concrete	Concrete
Height	190 meters	100 meters
Top width	10 meters	8 meters
Base width	150 meters	75 meters
Length	106 meters	150 meters
Volume of dam	740,000 M^3	350,000 M^3

2. Reservoir

Drainage area	142 km^2	140 km^2
Reservoir area	2 km^2	3.08 km^2
Maximum drawdown	-	20 meters
Total storage capacity	146x10^6 M^3	-
Effective storage capacity	-	61.6x10^6 M^3

3. Spillway

	Layout No. 1	Layout No. 2
Elevation of crest	700 meters	800 meters
Length	80 meters	80 meters
Capacity	2,000 cms	2,000 cms

4. Power Plant

Tunnel	2.0 km	4.7 km
Maximum head	350 meters	450 meters
Minimum flow	10 cms	9 cms
Total installed capacity	30,000 kw	34,000 kw
Firm energy annual output	263×10^6 kwh	298×10^6 kwh

Estimated Construction Cost

Dam	NT$\$250 \times 10^6$	NT$\$120 \times 10^6$
Waterway	15×10^6	38×10^6
Power house	30×10^6	32×10^6
Total	280×10^6	190×10^6

Benefit

1. Flood Control

This reservoir will reduce the river flood peak a great deal.

2. Irrigation

Below Chu-ying Power Plant, there is a quite big area which can be easily reclaimed. This new area and some area already cultivated can be sufficiently irrigated with the water from this reservoir.

3. Water Power

The power houses and their installation capacities have been described under "Engineering Features". The proposed installation capacity of the plant may be increased as the storage capacity of the reservoir is relatively big and the plant may take peak load as a peaking station.

The existing Tung-men and Chu-ying power plants downstream from this reservoir will be greatly benefited as the low water flow will

be increased from 5.56 cms to 12 cms after this reservoir is built. As calculated, the firm energy output will be increased by 116%. The installation capacity of both plants can be increased by 7,900 kw and the increased annual firm output will be about 70 million kwh.

Shan-chiao Reservoir Project (No. 88)

General Description

This project covers the construction of a 61.5-meter dam on the Pei Chi, a tributary of Ta-nan-ao Chi and three power stations with a total installed capacity of 42,000 kw. The water from the reservoir to the power stations will pass through a series of tunnels with a total length of 8,428 meters. The water from the last tailrace goes to I-lan-cho-shui Chi and will be utilized for irrigation.

Geology

Sandstone and slate are found at the dam site. The river bed is composed of gravels of various sizes.

Hydrology

The estimated maximum discharge at the dam site is 500 cms and the minimum is 1.0 cms. Hydrographs of 1935 to 1940 are available.

Engineering Features

1. Dam

Type	Concrete Gravity
Height	61.5 meters
Top width	3.5 meters
Base width	55.0 meters
Length	120.0 meters
Concrete volume	111,000 cubic meters

2. Reservoir

Watershed(35.8 sq. km on main river)	45.4 sq. km
Reservoir area	1 km^2
Maximum drawdown	20 meters
Total storage capacity	12.7×10^6 M^3
Effective storage capacity	9.4×10^6 m^3

3. Spillway

Crest elevation	815 meters
Length	100 meters
Capacity	460 cms

4. Power Plant Nos. 1 and 2 only

Total maximum available head	615 meters
Maximum usable flow	7.0 cms
Minimum regulated flow	3.35 cms
Total installed capacity	36,000 kw
Firm capacity	17,000 kw
Firm energy output	149×10^6 kwh

Estimated Construction Cost

Dam	NT$70 x 10^6
Tunnel	70 x 10^6
Power plants	60 x 10^6
Total	200 x 10^6

Benefit

1. Water Power

As estimated by the Taiwan Power Co., the proposed power plants with such big installed capacities, can take up a peaking load of 36,000 kw and the annual firm energy output would be about 149 million kwh.

2. Irrigation

The tailrace water will benefit 10,000 hectares of farming land which are now insufficiently irrigated by water of the I-lan-cho-shui Chi.

Wu-lao-keng Reservoir (No. 89)

General Description

The proposed dam site is located on the upper Wu-lao-keng Chi, about 1.5 kilometers above the railway bridge.

Geology

At the dam site, sandstone and shale are found. The river valley is in V-shape.

Hydrology

The estimated maximum discharge at the dam site is 300 cms and the minimum is 1.6 cms.

Engineering Features

1. Dam

Type	Concrete Gravity
Height	40 meters
Top width	3 meters
Base width	36 meters
Length	45 meters
Concrete volume	15,000 M^3

2. Reservoir

Drainage area	41.5 km^2
Reservoir area	0.47 km^2
Maximum drawdown	26.0 meters
Total storage capacity	7.1×10^6 M^3
Effective storage capacity	6.4×10^6 M^3

3. Spillway

Crest elevation	80 meters
Length	40 meters
Capacity	400 cms

Cost

The estimated cost of this project is NT$6,000,000.

Benefit

After the completion of this reservoir, the regulated flow of Wu-lao-keng Chi will be 5 cms. The water shortage problem of 2,068 hectares of cultivated land at the downstream will be solved.

Transportation Facilities

This dam site can be reached by highway and railway.

Tu-chang Reservoir (No. 90)

General Description

The proposed dam site is located on the upstream of I-lan-cho-shui Chi near Tu-chang Tsun. I-lan-cho-shui Chi has a rather broad width, mostly over 900 meters. At Tu Chang Tsun, the river gorge is relatively narrow. The bottom width of the proposed Tu-chang dam is only about 275 meters. The drainage area above the proposed dam site is 260 square kilometers and the river bed slope at the dam site is 1 to 60.

Geology

At the dam site, the river has a U-shape section. Rocks are mainly sandstones. River bed mainly consists of gravels of 5 cm to 10 cm in diameter.

Hydrology

The estimated maximum discharge at the dam site is 2,400 cms and the minimum discharge is 5 cms.

Engineering Features

1. Dam

Type	Concrete Gravity
Height	166 meters
Bottom width	406 meters
Concrete volume	3,030,000 M^3

2. Reservoir

Drainage area	260 square kilometers
Reservoir area	7.8 km^2
Maximum drawdown	100 meters
Total storage capacity	525 x 10^6 M^3
Effective storage capacity	465 x 10^6 M^3

3. Spillway

Crest elevation	600 meters
Length	200 meters
Capacity	2,000 cms

4. Power Plant

Maximum available head	160 meters
Average usable flow	19 cms
Total installed capacity	30,000 kw
Firm capacity	25,000 kw.
Firm energy, annual output	223×10^6 kwh

Estimated Construction Cost

Dam	NT\$910 x 10^6
Power plant	40 x 10^6
Total	NT\$950 x 10^6

Benefit

1. Flood Control

The total storage capacity of this reservoir is about 525 million cubic meters which is equal to 90% of the total runoff of the river basin in an average year. If this reservoir is operated principally for the regulation of the river flow a flood peak of average size might be entirely eliminated.

2. Water Power

As stated before, the firm capacity of the power plant is 25,500 kw. If it is a peak plant, the installation capacity of the power plant may be raised to 100,000 kw for 6-hour peaking. Furthermore, if this project were realized, the capacity of the existing plants - Yuan Shan and Tien-sung-pei - at the downstream could be raised by 140% as the minimum flow of the river will be raised from 8 cms to 19 cms.

3. Irrigation

After the completion of this reservoir, the irrigation of the cultivated area at the downstream will be greatly improved and the risk due to shortage of water can be eliminated to a great extent.

Transportation Facilities

The proposed dam site can be reached by the logging railway.

Yuan-shan Reservoir (No. 91)

Generaly Description

The proposed dam site is located on I-lan-cho-shui Chi near the existing Yuan-shan Intake. It is at the downstream of the proposed Tu-chang Dam Site and is at a distance of 4 km from Niu-tou Tsun. This is not a very economical site as the river bed is rather wide and the river bed slope at 1 to 70 is rather too steep.

Geology

Rock at the proposed dam site is sand stone and is suitable for building high dam. The river has a U-shape section at the proposed dam site.

Hydrology

The estimated maximum discharge at the dam site is 4,400 cms and the minimum is 9.2 cms. Hydrographs of 1937 and 1938 are available.

Engineering Features

1. Dam

Type	Concrete Gravity
Height	180 meters
Top length	560 meters
Concrete volume	5,500,000 M^3

2. Reservoir

Drainage area	463 km^2
Reservoir area	16.7 km^2
Maximum drawdown	100 meters
Total storage capacity	1,450 x 10^6 M^3
Effective storage capacity	1,220 x 10^6 M^3

3. Spillway

Crest elevation	420 meters
Length	400 meters
Capacity	4,000 cms

4. Power Plant

Maximum available head	180 meters
Average usable flow	32.5 cms
Total installed capacity	60,000 kw
Average power	45,500 kw
Average annual output	400×10^6 kwh

Estimated Construction Cost

Dam	NT$1,650 $\times 10^6$
Power Plant	80 $\times 10^6$
Others	20 $\times 10^6$
Total	NT$1,750 $\times 10^6$

Benefits

1. Flood Control

If this reservoir is kept empty, it can store the major portion of any flood flow.

2. Water Power

The benefit for power is detailed under "Engineering Features". After the completion of this reservoir, the silt problem of the two existing plants at the downstream can be solved.

3. Irrigation

After the completion of this reservoir, more reclaimed land at the downstream can be properly irrigated.

Shuang-lien-pi Reservoir (No. 92)

General Description

Shuang-lien-pi is a pond situated at a distance of 10 km to the west of I-lan City. It is at an elevation of 400 meters above the sea level. This pond has an outlet to a small creek and then to the sea. This project covers the construction of a dam at the outlet in order to raise the storage capacity of the natural pond. The drainage area of the pond is very small. For the purpose of getting more water, water of Nan-shih Chi has to be diverted into this reservoir.

Geology

Rock at the dam site is sandstone. The natural outlet of the pond has a V-shape section.

Engineering Features

1.	Dam	
	Type	Concrete gravity
	Height	40 meters
	Length	230 meters
	Volume of the dam	40,000 M^3
2.	Reservoir	
	Drainage area	20 km^2
	Reservoir area	1 km^2
	Maximum drawdown	20 meters
	Total storage capacity	22 x 10^6 M^3
	Effective storage capacity	17 x 10^6 M^3
3.	Spillway	
	Crest elevation	400 meters
	Length	60 meters
	Capacity	200 cms
4.	Diversion Tunnel	
	Length	2.7 km

5. Power Plant

Maximum head	300 meters
Maximum usable flow	4 cms
Total installation capacity	10,000 kw
Firm capacity	7,000 kw
Annual firm energy output	60×10^6 kwh

Estimated Construction Cost

Dam	NT$20 $\times 10^6$
Diversion tunnel	6×10^6
Power station	17×10^6
Total	NT$43 $\times 10^6$

Benefits

1. Water Power

As detailed under "Engineering Features".

2. Irrigation

After the completion of this reservoir, the menace of shortage of water for 685 hectares of irrigated land along Wu-shih Chi will be eliminated.

GEOGRAPHICAL NAMES

(South & East Taiwan)

South Taiwan

A

A-li-shan Station 阿里山測站
Ai-liao 隘寮
Ai-liao Chi 隘寮溪
Ai-liao Reservoir 隘寮水庫
Ai-liao Levee 隘寮堤防
Ai-liao Main Canal 隘寮幹渠
Ai-liao-nan Chi 隘寮北溪
Ai-liao-pei Chi 隘寮南溪
Ai-liao Reservoir 隘寮水庫
A-kung-tien Chi 阿公店溪
A-kung-tien Reservoir 阿公店水庫
A-kung-tien Station 阿公店測站
A-lien 阿蓮
A-lien Hsiang 阿蓮鄉
An-wa-na 紅花子（安哈那）
An-wa-na Reservoir 紅花子水庫
A-tui-lu (Aderu) 阿對魯(阿段魯，阿耽咯)

B

Bon-ga-ri (Wang-chia) 那戛里社（望嘉，蒙伽利）

C

Central Range (Chung-yang-shan-mai) 中央山脈
Chang-nao-liao 樟腦寮
Chang-pan Tsun 常盤村
Chao-an-liao 詔安寮
Chao-chow 潮州
Chao-chow Chen 潮州鎮
Chao-hsing Tsun 照興村
Chao-yuan-szu (Temple) 朝元寺
Chao-yuan-szu Chi 朝元寺溪
Chao-yuan-szu Reservoir 朝元寺水庫
Che-cheng 車城
Che-cheng Hsiang 車城鄉
Chen-hsing 振興
Chia-hsien 甲仙（東安）
Chiai-ta Station 介達測站
Chia-jui-chi 加蚋崎（加納崎）
Chia-jui-chi Chi 加蚋崎溪
Chia-jui-chi Reservoir 加蚋崎水庫
Chia-nan Canal 嘉南大圳
Chia-nan Hydraulic Association 嘉南水利委員會
Chiao-li-lin 交力林
Chiao-li-lin Chi 交力林溪
Chiao-li-lin Reservoir 交力林水庫
Chiao-tou Hsiang 橋頭鄉
Chiao-tzu-tou 橋子頭
Chia-wu-she Chi 卡烏社溪
Chia-yi 嘉義
Chia-yi Hsien 嘉義縣
Chia-yi Regional Office 嘉義分會
Chi-chia Tsun 七佳村
Chieh-pa 茄拔
Chieh-tung-keng 茄苳坑
Chieh-tung Chi 茄苳溪
Chien-feng 前峯
Chien-pu-tso 前埔厝
Chien-shan-pi 尖山埤
Chien-shan-pi Reservoir 尖山埤水庫
Chien-ta-pu 前大埔
Chih-lan Chi 赤蘭溪
Chih-pen Chi 知本溪

Chih-shan	赤山
Chi-hsin	溪心
Chi-nan	旗南
Chi-nan Reservoir	旗南水庫
Chi-nan-shan Station	溪南山測站
Ching-pu	菁埔
Ching-pu-tzu-keng	青埔子坑
Ching-shui	清水
Chin-huang	近黃
Chin-shui-ying	浸水營
Chi-pei-shua	吉貝耍
Chi-shan	旗山
Chi-shan Canal	旗山圳
Chi-shui Chi	急水溪
Chi-ti-liao	溪底寮
Chi-tou	崎頭
Chiu-chiung-keng	九芎坑
Chiu-chiung-lin	九芎林
Chiu-chuang	舊庄
Chiu-chu-tang	九曲堂
Chi-wei	旗尾
Cho-kow	濁口
Cho-kow Chi	濁口溪
Cho-kow Reservoir	濁口水庫
Chuan-tzu-yao	磚子窯
Chu-chi	竹崎
Chu-chi Hsiang	竹崎鄉
Chung-chi Chi	中崎溪（深水溪）
Chung-chih-kwan	中止關
Chung-chow	中洲
Chung-keng-tzu Chi	中坑子溪
Chung-lin	中林
Chung-pu	中埔
Chung-tan	中壇
Chung-tzu-pu	塚子埔（新發村）
Chu-tou-chiao	竹頭角
Chu-tou-chiao Canal	竹頭角圳
Chu-tzu-chiao	竹子腳
Chu-tzu-liao	竹子寮
Chu-tzu-men	竹子門（竹門）
Chu-wei	竹圍（玉井鄉）
Chu-wei	竹惟（東山鄉）
Coral Lake	珊珠湖
Coral Lake Reservoir (Wu-shan-tou Reservoir)	珊珠湖水庫（烏山頭水頭）

E

Erh-chia	二甲（沙崙）
Erh-chung-chi	二重溪
Erh-pu	二埔
Erh-tseng-hsing (Erh-tseng-hang)	二層行
Erh-tseng-hsing Chi	二層行溪
Erh-tseng-hsing Reservoir	二層行水庫

F

Fang-liao	枋寮
Fan-she	番社
Fan-tzu-ling	番子嶺
Fan-tzu-tien	番子田
Fen-chi-hu	奮起湖（河東里）
Feng-kang	楓港
Feng-kang chi	楓港溪
Feng-pi-tou	鳳鼻頭
Feng-shan	鳳山
Feng-shan-tso	鳳山厝
Feng-wei-tso	鳳尾厝
Formosa Strait	臺灣海峽
Fu-hsing	福興

G

Gara She	喀拉社

H

Hai-feng-tso	海豐厝（玉豐里）

Hao-shou	好收
Hao-shou Canal	好收圳
Heng-chun	恆春
Hou-ching Chi	後勁溪
Hou-ku Chi	後堀溪
Hsia-keng	下坑
Hsia-keng Reservoir	下坑水庫
Hsiang-yang	向陽
Hsiao-chiao-tui	小腳腿
Hsiao-kang	小港
Hsiao-lin	小林
Hsiao-mei	小梅 (梅山)
Hsia-tan-shui Chi	下淡水溪
Hsien-tsao-pu	仙草舖
Hsi-kow	西口
Hsin-chih	新置
Hsin-chih Farm Office	新置農場事務所
Hsin-chu	新竹
Hsin-chuang	新庄
Hsin-chu Series	新竹系
Hsin-feng	新豐
Hsin-hwa	新化
Hsin-hwa Hsiang	新化鄉
Hsin-hwa Regional Office	新化分會
Hsin-kai	新開
Hsin-kao	新高
Hsin-pi	新埤
Hsin-pu	新埔
Hsin-shih	新市
Hsin-tso	新厝
Hsin-wei	新威
Hsin-ying	新營
Hsin-ying Alchohol Distillery	新營酒精廠
Hsin-ying Paper Factory	新營紙廠
Hsin-ying Sugar Factory	新營糖廠
Hsu-hsien Chi	許縣溪
Hsu-hsien Canal	許縣圳
Hu-nei Hsiang	湖內鄉
Hu-shen-keng	呼神坑
Hu-tou Chi	虎頭溪
Hu-tou-pi	虎頭埤
Hu-tzu	湖子
Hu-wei-liao	虎尾寮
Hwa-lo	華洛

I

I-jen Tsun	義仁村

J

Jen-teh	仁德
Jen-teh Hsiang	仁德鄉
Jen-wu	仁武
Jen-wu Hsiang	仁武鄉

K

Kang-kow Chi	港口溪
Kang-shan	岡山
Kang-shan Chen	岡山鎮
Kan-hsia-liao	炭下寮
Kan-ting	炭頂
Kan-tzu-tou	炭子頭
Kao-hsiung	高雄
Kao-hsiung Hsien	高雄縣
Kao-shu	高樹
Keng-kow	坑口
Keng-nei	坑內
Keng-nei Chuang	坑內庄
Keng-nei Reservoir	坑內水庫
Keng-tou-tso	坑頭厝
Keng-tzu-ping	坑子坪
Ko-li	科裡
Kow-she	口社
Kow-she Chi	口社溪
Ku-hsia	古夏

Ku-kwa-liao	苦瓜寮
Kung-li	噴哩
Kuo-chi	過溪
Kuo-kow	過溝
Kuo-shan (Kai-yuan-huo)	過山 (開元後)
Kuo-yi-hou (Kuo-yi)	果毅後 (果毅)
Kwan-miao	關廟
Kwan-miao Reservoir	關廟水庫
Kwan-shan Chi	關山溪 (唯金溪)
Kwan-tien	官田
Kwan-tien Chi	官田溪
Kwan-tzu-ling	關子嶺
Kwan-yin-ting	觀音亭
Kwei-chung	龜重
Kwei-chung Chi	龜重溪
Kwei-chung Reservoir	龜重水庫
Kwei-jen	歸仁
Kwei-jen Hsiang	歸仁鄉
Kwei-shan	龜山
Kwei-tan	龜丹
Kwei-tan Chi	龜丹溪
Kwei-tan Reservoir	龜丹水庫
Kwei-tung	龜洞
Kwei-tzu-kong	鬼子空

L

Lai-po-an She	賴婆安社 (來布安社)
Lai-she	來社
Lai-she Chi	來社溪
Lai-she Reservoir	來社水庫
La-ke-szu Chi (Rakkusu kei)	拉克斯溪 (拉克庫斯溪)
Lao-nung Chi	老濃溪
Lao-nung Tsun	老濃村
Lao-pi	老埤
Lao-tu-keng	磅礴坑
La-po-lan	辣婆藍 (梅蘭)
La-tzu-ko-yin Chi	拉子可印溪 (拉庫印溪)
Liang-shan	涼山
Liang-shan Reservoir	涼山水庫
Li-kang	里港
Li-ly	力里 (力力)
Li-ly Chi	力里溪 (力力溪)
Li-ly Reservoir	力力水庫(力里水庫)
Lin-feng-ying	林鳳營
Ling-kow	嶺口
Ling-shan-chiao	陵山脚
Lin-lo	麟洛
Lin-pien	林邊
Lin-pien Chi	林邊溪
Lin-tzu-chien	林子前
Lin-tzu-tou	林子頭
Lin-tzu-wei	林子尾 (秀林村)
Liu-chia	六甲
Liu-chung	六重
Liu-chung Chi	六重溪
Liu-chung Reservoir	六重水庫
Liu-kwai-tso	六塊厝
Liu-kwei	六龜
Liu-kwei Hsiang	六龜鄉
Liu-kwei-li	六龜里
Liu-shuang	六雙
Liu-ying	柳營
Li-yu-shan	鯉魚山
Lu-chu Hsiang	路竹鄉
Lu-liao	鹿寮
Lu-liao Chi	鹿寮溪
Lu-liao Reservoir	鹿寮水庫
Lu-ma-chan	鹿麻產
Lun-tzu-ting	崙子頂 (崙頂村)
Lu-tao	鹿陶
Lu-tao-yang	鹿陶洋
Lu-teng-hu	盧籐湖
Lu-tso-wa	鹿厝挖

M

Ma-chia Hsiang	瑪家鄉
Maga She (Ma-ya)	馬戛社，茂林，麥軋，瑪雅村
Maga Tsun	馬雅只
Mang-tzu-mang	芒子芒
Man-tu-lan She	滿吐蘭社（萬頭蘭）
Mao-tzu-pu	茅子埔
Ma-pu	麻埔
Ma-tsu-miao	媽祖廟（媽廟村）
Mei-hwa-tan	梅花潭
Mei-hwa-tan Reservoir	梅花潭水庫
Mei-nung	美濃
Mei-nung Chen	美濃鎮
Mei-nung Chi	美濃溪
Mei-nung Reservoir	美濃水庫
Mei-piao	美彪（皮皮欲）
Mei-shan	梅山（小梅）
Mei-shan Hsiang	梅山鄉
Me-szu-huo-wa-lu She	麥斯霍娃魯社
Mien-chien-pu	面前埔
Min-chuan Tsun	民權村
Min-hsiung	民雄
Min-hsiung Hsiang	民雄鄉
Min-hsiung Working Station	民雄工作站
Min-tsu Tsun	民族村
Mi-to	彌陀
Mi-to Hsiang	彌陀鄉
Mt. A-li	阿里山
Mt. Chi-nan	溪南山
Mt. Chi-pen	知本山
Mt. Erh-yu	兒玉山
Mt. Hsiao-kang	小崗山
Mt. Hsin-kao	新高山
Mt. Hsiu-ku-luan	秀姑巒山
Mt. I-tin	衣丁山
Mt. Kwan	關山
Mt. Kwan-yin	觀音山
Mt. Lu-ping	鹿坪山
Mt. Mu-tan	牡丹山
Mt. Mu-tan-chi	牡丹溪山
Mt. Nan-shuang-tou	南雙頭山
Mt. Pei-nan	卑南山
Mt. Ping-ting	平頂山
Mt. Ta-kang	大崗山
Mt. Ta-wu	大武山
Mt. Wu-tou	霧頭山
Mung-chia-li (Bon-ga-ri)	蒙伽利
Mu-tan-chi	牡丹溪
Mu-tan She (Mou-tan She)	牡丹村

N

Nan-ching	南靖
Nan-ching Sugar Factory	南靖糖廠
Nan-chow	南洲
Nan-hsi	楠西
Nan-hsi Hsiang	楠西鄉
Nan-hsi Reservoir	楠西水庫
Nan-hu	南湖
Nan-hu Chi	南湖溪
Nan-hu Reservoir	南湖水庫
Nan-hwa Tsun	南華村（花園）
Nan-shih-hu	南世湖（南世）
Nan-shih-hu Chi	南勢湖溪
Nan-shih-hu Reservoir	南勢湖水庫
Nan-shih-keng (Ta-nan Tsun)	南勢坑（大南村）
Nan-shih-tzu	南勢子
Nan-tzu	楠梓
Nan-tzu Hsiang	楠梓鄉
Nan-tzu-hsien Chi	楠梓仙溪
Nan-tzu-liao	楠子寮
Na-pa-lin	那拔林
Na-pa-lin Chi	那拔林溪

Na-pa-lin Reservoir	那拔林水庫
Nei-lin	內林
Nei-men	內門
Nei-men Hsiang	內門鄉
Nei-pu	內埔
Nei-pu-tzu	內埔子
Nei-pu-tzu Reservoir	內埔子水庫
Niu-chow Chi	牛稠溪
Niu-chow-pu	牛稠埔
Niu-chuang	牛庄
Niu-ju-chi	牛肉崎
Niu-shih-keng	牛食坑

O

O-luan-pi	峨巒鼻

P

Pa-chang Chi	八掌溪
Pa-chia	八甲
Pa-chiao-tse	芭蕉宅
Pai-chien (Haisen)	排剪，(高中)
Pai-ho	白河
Pai-ho Chen	白河鎮
Pai-ko-hai	柏哥海
Pai-shui	白水
Pai-shui Chi	白水溪
Pai-shui-chi Reservoir	白水溪水庫
Pai-shui-chi Tsun	白水溪村
Pa-li-sheng She	琵里笙社
Pao-lai	寶來
Pao-lai Chi	寶來溪
Pao-lai Reservoir	寶來水庫
Park of Mei-shan Hsiang	梅山鄉公園
Pa-tung-kwan	八通關
Pa-yu Chi	拔柚溪
Pei-kang	北港
Pei-kang Chi	北港溪
Pei-kang-chi	北港溪（村）
Pei-ma	北馬（番社村）
Pei-shih	北勢
Pei-shih Chi	北勢溪
Pei-shih-chow	北勢洲
Pei-shih-lin	北勢林
Pei-shih-lin Chi	北勢林溪
Pei-shih-lin Reservoir	北勢林水庫
Ping-lu-tao	濱鹿洶
Ping-tung	屏東
Pi-pi-yu (Bibiu)	皮皮欲（復興村）
Pi-tzu-tou	埤子頭（昇安里）
Po-tzu	朴子
Po-tzu Chi	朴子溪
Po-tzu-pu	朴子埔
Pu-tai	布袋

S

San-chang-kuo	三張廓
San-chien-tso	三間厝
San-nai-tan	三奶壇（觀音村）
San-shih-liu-lun	三十六崙
San-tieh Chi	三疊溪
San-ti Hsiang	三地鄉
San-ti-men	三地門（三地，山地盟）
Sa-pi-chi (Sa-mi-chi)	薩匹基（砂米箕）
Sha-lun-tzu	沙崙子
Shan-chiao Tsun	山脚村
Shan-chu-tao	山豬淘
Shang-chuang	上庄
Shang-lao-nung	上老濃
Shang-lun-tzu	上崙子（上崙村）
Shan-lin	杉林
Shan-lin Hsiang	杉林鄉
Shan-shang	山上
Shan-shan-lin	山杉林
Shan-tzu-chiao (Hsu-shan Tsun)	山子脚（旭山村）

Shan-tzu-ting	山子頂
Sha-tzu-tien	沙子田
Sha-tzu-tien Chi	沙子田溪
Shen-fan-lai Chi	生番來溪
Shen-keng-tzu	深坑子
Shen-keng-tzu Chi	深坑子溪
Shen-keng-tzu Reservoir	深坑子水庫
Shen-shui	深水
She-pi	社皮
She-tzu	社子
Shih-chang-li	十張犁
Shih-che	石車
Shih-chiu-wan	十九灣
Shih-eh-tou	獅額頭
Shih-lung	獅龍
Shih-lung Chi	獅龍溪
Shih-lung-kou	獅龍溝
Shih-lung Reservoir	獅龍水庫
Shih-men	石門
Shih-miao	石廟
Shih-tou-ying	石頭營
Shih-tzu-tou	獅子頭
Shih-tzu-tou Canal	獅子頭圳
Shih-tzu-tou Chi	獅子頭溪
Shih-tzu-tou Reservoir	獅子頭水庫
Shou	壽
Shuai-mang Chi	率芒溪
Shuang-chi	雙溪
Shui-shang	水上
Shui-ti-liao	水底寮
Shui-tui	水對
Stone Gate	石門
Sung-tzu-chiao	松子脚（松脚）
Szu-chung Chi	四重溪（溫泉村）
Szu-chung-chi Reservoir	四重溪水庫

T

Ta-chiao-tui	大脚腿
Ta-chi-chiao	大崎脚
Ta-chuang	大庄（大客村）
Ta-hsiang-ying	大嶂營
Ta-hsiang-ying Farm	大嶂營農場
Tai-kang	太康
Tai-ma-li	太麻里
Tai-ma-li Chi	太麻里溪
Tai-nan	臺南
Tai-pei	臺北
Tai-tzu-miao	太子廟（太子村）
Ta-kang-shan	大崗山（村）
Ta-kang-shan Station	大崗山測站
Ta-ka-nu-wan	塔喀奴丸（五權，他卡奴娃）
Ta-la-lu Chi	達拉爾溪
Ta-la-lu She	達拉魯社（達拉爾社）
Ta-la-me-ku She	達拉參庫社
Ta-la-ta-la She	達拉達拉社
Ta-lin	大林
Ta-lin Fault	大林斷層
Ta-me-huo She	他參霍社（玉穗，建山）
Ta-na-hsiu	塔那修
Tao-kung-shan	到孔山
Tao-kung-shan Chi	到孔山溪
Ta-pai-chu	大排竹（大竹里）
Ta-pang	達邦
Ta-pan-tien-liao	大半天寮
Ta-ping	大坪
Ta-ping-ting	大坪頂
Ta-pu	大埔
Ta-pu Chi	大埔溪
Ta-pu-mei	大埔美
Ta-pu Reservoir	大埔水庫
Ta-she	大社
Ta-she Hsiang	大社鄉
Ta-tan	大潭
Ta-tsao-pu	大草舖
Ta-tsin	大津
Ta-wu	大武

Ta-wu Chi	大武溪
Teh-yuan-pi	德元埤
Teh-yuan-pi Reservoir	德元埤水庫
Te-wen (To-ku-bun)	德文
Tien-liao	田寮
Tien-liao Hsiang	田寮鄉
Tien-liao Reservoir	田寮水庫
Tien-yang-tzu	田洋子
Ting-hsiu-yu	頂秀祐
Ting-su	頂蘇
Ting-tan	頂潭
To-na She	托那社（多納村）
Tou-chien Chi	頭前溪（白水溪支流）
Tou-lin	頭林
Tou-liu	斗六
Tsao-kung	曹公
Tseng-wen Chi	曾文溪
Tso-ying	左營
Tsung-tu-pi	總督埤
Tu-kou	土溝
Tu-lung-wan	土壠灣
Tu-lung-wan Reservoir	土壠灣水庫
Tung-a-li-kwan	東阿里關（阿里關）
Tung-hsi-yen	東西煙
Tung-hu Tsun	東湖村
Tung-kang	東港
Tung-kang Chi	東港溪
Tung-kow	東口
Tung-shan	東山
Tung-shan Reservoir	東山水庫
Tung-ta-chiu-yuan	東大邱園（大邱園）
Tzu-tung-chi	薊桐崎
Tzu-tung-chiao Chi	薊桐脚溪
Tzu-tung-chi Tsun	薊桐崎村

W

Wa-lu-szu Chi	窪魯斯溪
Wang-lai-tse	王萊宅
Wan-li-chiao	萬里橋
Wan-lung	萬隆
Wan-tan	萬丹
Wa-tzu-chiao	凹子脚（大客村）
Wei-liao	尾寮
Wen-chuan Tsun	溫泉村（四重溪）
Wen-tso-pu Chi	溫厝廍溪
Wen-tzu-chih	蚊子只
Wu-chia	五甲
Wu-lai	烏來
Wu-lai Series	烏來系
Wu-lo	武洛
Wu-lo Chi	武洛溪
Wu-ming Chi	無名溪
Wu-pien-tou	五汴頭
Wu-shan-keng	烏山坑
Wu-shan-keng Reservoir	烏山坑水庫
Wu-shan-tou	烏山頭
Wu-shan-tou Reservoir	烏山頭水庫
(Coral Lake)	（珊湖潭）
Wu-sung	烏松
Wu-sung Hsiang	烏松鄉
Wu-tou	霧頭
Wu-tsai-lin	烏材林
Wu-tung Tsun	武東村（刣豬厝）

Y

Yale	雅爾（雁爾，卡尼）
Yang-tzu-chiao	樣子脚（建山村）
Yang-tzu-keng	樣子坑
Yeh-tzu-liao	葉子寮
Yen-chao Hsiang	燕巢鄉
Yen-erh	雁爾（雅爾）
Yen-kwan	鹽舘
Yen-kwan Reservoir	鹽舘水庫
Yen-pu	鹽埔

Yen-shni Chi	鹽水溪	Yu-che-tien	油車店
Yen-shui Reservoir	鹽水水庫	Yu-ching	玉井

East Taiwan

A

A-yu 阿育

B

Bon-bon-shan Station 崩崩山 (綳綳山)測站

C

Central Range (Chung-yang-shan-mai) 中央山脈
Chia-li-wan 加禮灣
Chi-an 吉安
Chiao-chi 礁溪
Chien-chin 見晴
Chih-hsioh 志學
Chih-shang 池上
Chih-ya-kan 知亞干
Chih-ya-kan Chi 知亞干溪
Chi-kow 溪口
Ching-shui 清水
Ching-shui Chi 清水溪
Ching-shui No..1 Plant 清水一號電廠
Ching-shui No. 2 Plant 清水二號電廠
Cho Chi 卓溪
Cho-lu 卓麓
Chueh 蕨
Chu-ying 初英
Chu-ying Power Plant 初英發電廠

F

Feng 楓
Feng-lin 鳳林
Feng-tien 豐田
Fu-li 富里
Fu-lo 福樂
Fu-tien 富田
Fu-tien Chi 富田溪
Fu-tien Reservoir 富田水庫
Fu-yuan 富源
(Pa-tzu) (拔子，白川)

H

Han-chi 寒溪
Hsiang-yang 向陽
Hsin-cheng 新城
Hsin-kang 新港 (成功)
Hsin-wu-lu 新武呂 (新武)
Hsin-wu-lu Chi 新武呂溪
Hsiu-ku-luan 秀姑巒
Hsiu-ku-luan Chi 秀姑巒溪
Hsiu-ku-luan Reservoir 秀姑巒水庫
Huan Chi 磺溪
Hung-yeh Chi 紅葉溪
Hung-yeh-ku 紅葉谷
Hwa-lien 花蓮
Hwa-lien Chi 花蓮溪

I

I-lan 宜蘭
I-lan-cho-shui Chi 宜蘭濁水溪
I-lan Hsien 宜蘭縣

J

Jui-sui (Jui-hui) 瑞穗
Jui-sui Canal 瑞穗圳

K

Kao-hsiung 高雄
Kao-yuan Reservoir 高原水庫

Kao-yuan Tsun	高原村（泰源）
Keelung	基隆
Ki-nan-pu	禧南僕
Kung-pu	公舖
Kwang-fu	光復
Kwan-shan	關山

L

La-ku-la-ku (Ra-ku-ra-ku Chi)	拉苦拉苦溪（樂苦樂苦溪）
Lao Chi	荖溪
Li-chia Canal	利家圳
Li-lung	里壠
Li-wu	立霧
Li-wu Chi (Ta-ke-li Chi)	立霧溪
Li-wu Power Plant	立霧發電廠
Li-yu-chih	鯉魚池
Li-yu-chih Reservoir	鯉魚池水庫
Lo-tung	羅東
Lu-chia	呂家
Lu-chia Chi	呂家溪
Lu-liao Chi	鹿寮溪
Lu-ming	鹿鳴
Lung--chien Reservoir	瀧見水庫
Lung-chien Tsun	瀧見村
Lu-yeh	鹿野

M

Ma-lan-tiao Chi	馬蘭釣溪
Mao-kung Chi	猫公溪（八里灣溪）
Ma-tai-an	馬太鞍
Ma-tai-an Chi	馬太鞍溪
Ma-wu-ku	馬武窟
Ma-wu-ku Chi	馬武窟溪
Mi-lun Chi	米崙溪
Mt. Chi-chiao	七脚山
Mt. Chi-chiao-chuan	七脚川山
Mt. Chi-hsing	七星山
Mt. Chi-pen	知本山
Mt. Ho-huan	合歡山
Mt. Li-yu	鯉魚山
Mt. Mao-kung-fu-shih	猫公富士山
Mt. Mu-kua	木瓜山
Mt. Nan-hu-ta	南湖大山
Mt. pa-to-lu	帕托魯山
Mt. San-hsing	三星山
Mt. Ta-pai	大白山
Mu-kua Chi	木瓜溪

N

Nan-ao	南澳
Nan-hsing	南興
Nan-shih Chi	南勢溪
Nan-tzu	楠梓
Nei-yuan-shan	內員山
Niu-tou	牛門

P

Pai-a-pai (Pai-tzu-pai)	擺阿擺（擺子擺，和平）
Paicific Ocean	太平洋
Pa-ta-kan	巴他干
Pa-tu	八堵
Pei Chi	北溪
Pei-nan	卑南
Pei-nan Canal	卑南大圳
Pei-nan-ta Chi	卑南大溪
Pei-pu	北埔
Pei-pu Canal	北埔圳
Pei-pu Thermo Plant	北部火力發電廠
Pei-szu-chiu Chi	北絲鬮溪
Pieh Chi (Pai-ko Chi)	鱉溪（白克溪）
Ping-chuan	品川
Ping-lin	平林
Pi-ya-haw	皮亞號（披亞號）
Pi-ya-nan	壁亞南

Po-pu-wu	破布烏
Po-sai-kan	婆賽干

S

San-chan	三棧
San-chan Chi	三棧溪
San-chien-wu	三間屋
San-hsing	三星
San-li	三笠
San-min	三民
San-tai	三台
San-tai Reservoir	三台水庫
Sea Shore Range (Hai-an-shan-mai)	海岸山脈
Shan-chiao	山腳
Shan-chiao Reservoir	山腳水庫
Sha-po-tang Chi	沙婆礑溪
Shih-tung	石洞
Shou	壽
Shou-feng	壽豐
Shuang Chi	雙溪
Shuang-lien-pi Reservoir	雙蓮埤水庫
Shui-lien	水連
Su-ao	蘇澳
Szu-chi	四季

T

Ta-cho-shui	大濁水
Ta-cho-shui Chi	大濁水溪
Ta-chuan	大庄
Ta-ho	大和
Tai-pa-liu-chiu	太巴六九
Tai-pa-liu-chiu Chi	太巴六九溪
Tai-pei	臺北
Tai-ping	太平
Tai-ping Chi	太平溪
Tai-ping-shan Station	太平山測站
Tai-tung	臺東
Ta-ke-li Chi	塔克里溪
Ta-kwan	大觀
Ta-na-mei	打那美
Ta-nan	大南
Ta-nan-ao	大南澳
Ta-nan-ao Chi	大南澳溪
Ta-nan Chi	大南溪
Tao-yeh	稻葉
Ta-sao-pieh	大掃別
Tien-chang Cliff	天長斷崖
Tien-sung-pi Power Plant	天送埤發電廠
Tou-cheng	頭城
Tu-chang Dam	土場壩
Tu-chang Reservoir	土場水庫
Tu-chang Tsun	土場村
Tung-li	銅里
Tung-men	銅門
Tung-men Power Plant	銅門發電廠
Tung-neng-kao	東能高
Tung-shan	冬山

W

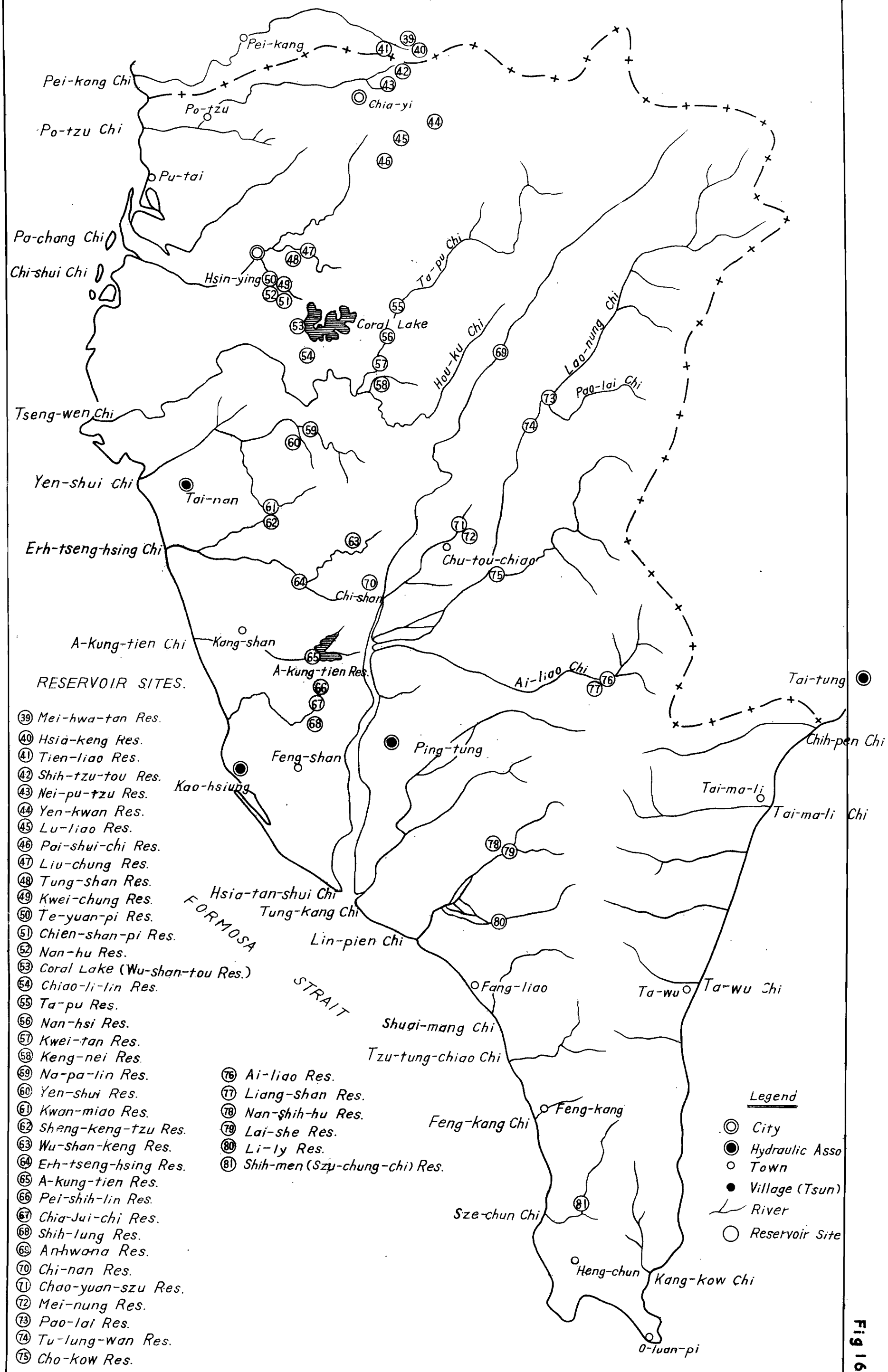
Wan-li-chiao	萬里橋
Wan-li-chiao Chi	萬里橋溪
Wan-ta Sub-station	萬大變電所
Wu-i-li	烏伊里
Wu-lao-keng Chi	武荖坑溪
Wu-lao-keng Reservoir	武荖坑水庫
Wu-lao-keng Tsun (Buroko)	武荖坑村
Wu-mao	烏帽
Wu-shih Chi	五十溪

Y

Yen-wan	岩灣
Yuan-shan Intake	圓山進水口
Yuan-shan Power Plant	圓山發電廠
Yuan-shan Reservoir	圓山水庫
Yueh-mei	月眉
Yu-li	玉里

LOCATION MAP OF RESERVOIR SITE IN SOUTH TAIWAN

Scale 1 : 500,000

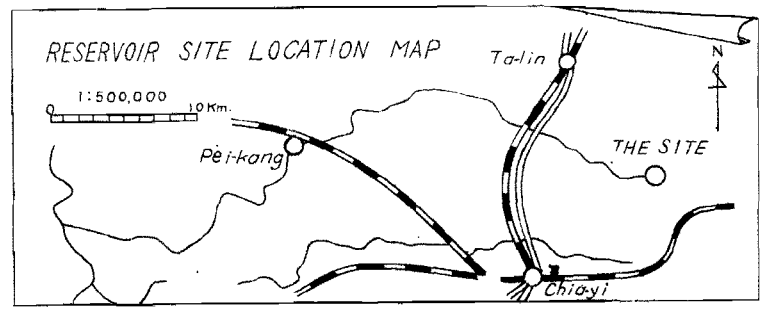


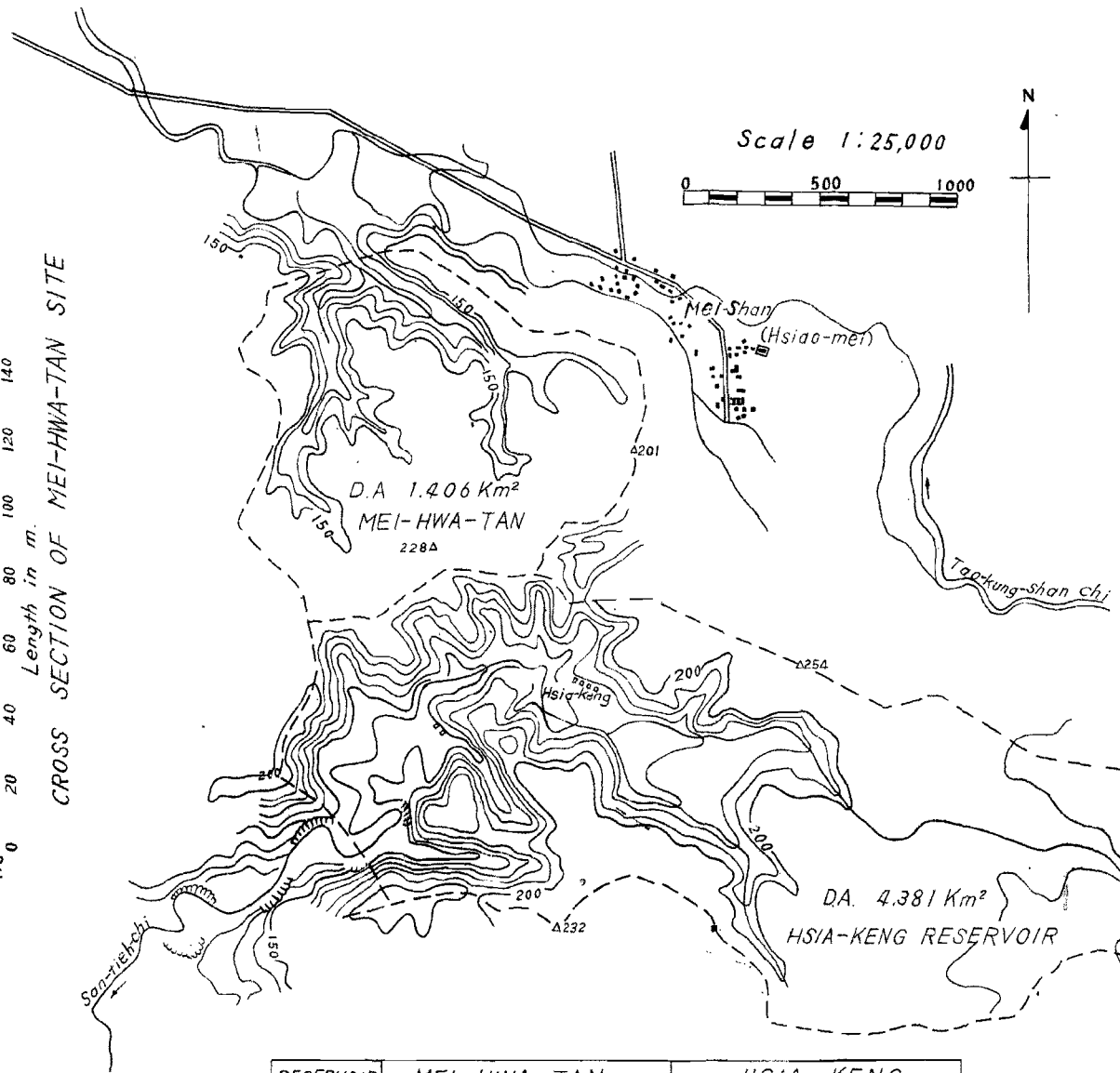
RESERVOIR SITES.

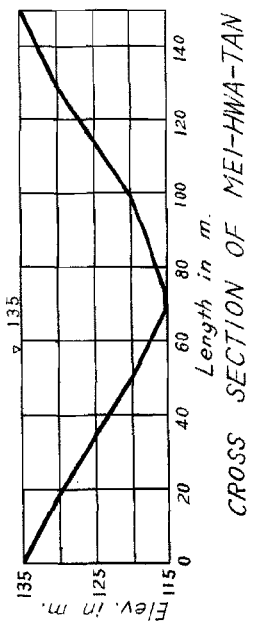
(39) Mei-hwa-tan Res.
(40) Hsia-keng Res.
(41) Tien-liao Res.
(42) Shih-tzu-tou Res.
(43) Nei-pu-tzu Res.
(44) Yen-kwan Res.
(45) Lu-liao Res.
(46) Pai-shui-chi Res.
(47) Liu-chung Res.
(48) Tung-shan Res.
(49) Kwei-chung Res.
(50) Te-yuan-pi Res.
(51) Chien-shan-pi Res.
(52) Nan-hu Res.
(53) Coral Lake (Wu-shan-tou Res.)
(54) Chiao-li-lin Res.
(55) Ta-pu Res.
(56) Nan-hsi Res.
(57) Kwei-tan Res.
(58) Keng-nei Res.
(59) Na-pa-lin Res.
(60) Yen-shui Res.
(61) Kwan-miao Res.
(62) Sheng-keng-tzu Res.
(63) Wu-shan-keng Res.
(64) Erh-tseng-hsing Res.
(65) A-kung-tien Res.
(66) Pei-shih-lin Res.
(67) Chia-Jui-chi Res.
(68) Shih-lung Res.
(69) An-hwa-na Res.
(70) Chi-nan Res.
(71) Chao-yuan-szu Res.
(72) Mei-nung Res.
(73) Pao-lai Res.
(74) Tu-lung-wan Res.
(75) Cho-kow Res.
(76) Ai-liao Res.
(77) Liang-shan Res.
(78) Nan-shih-hu Res.
(79) Lai-she Res.
(80) Li-ly Res.
(81) Shih-men (Szu-chung-chi) Res.

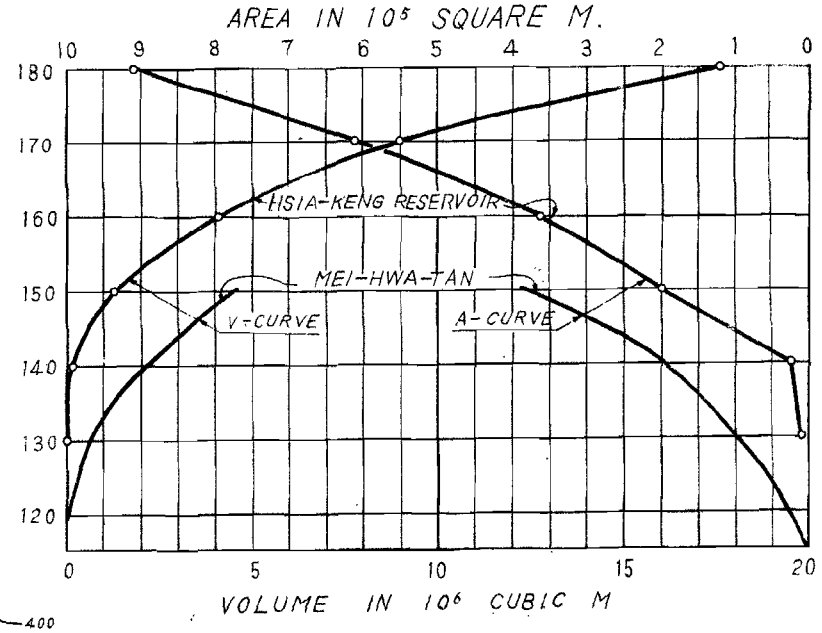
Fig 160

MEI-HWA-TAN & HSIA-KENG RESERVOIRS

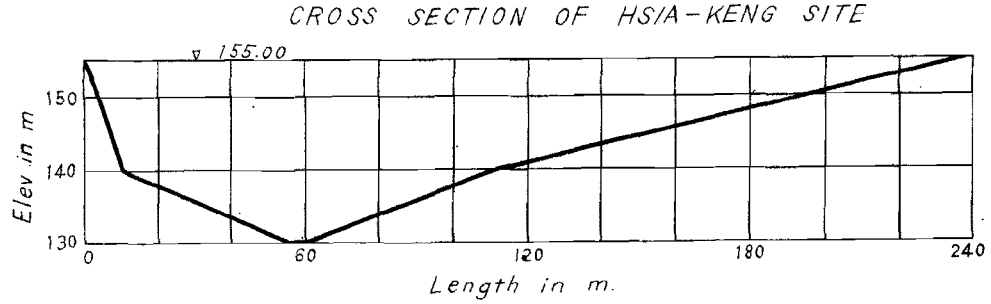








RESERVOIR	MEI-HWA-TAN		HSIA-KENG	
Elev.	A m²	V m³	A m²	V m³
115	0	0		
120	25000	62,500		
130	93,750	656,250		0
140	193,750	2,093,750	25,000	187,500
150	381,250	4,468,750	200,000	1,312,500
160			362,500	4,125,000
170			612,500	9,000,000
180			906,250	16,593,750



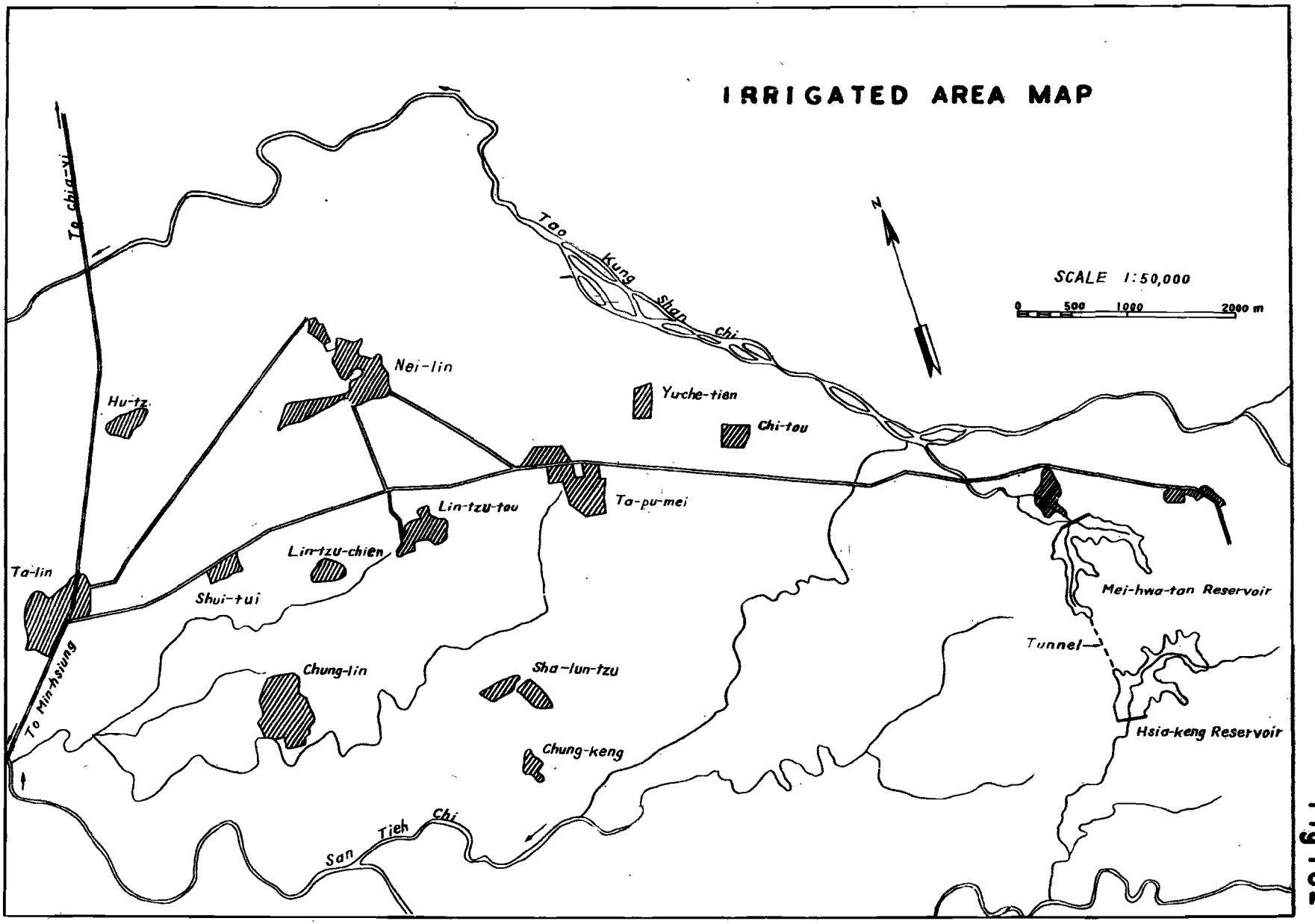
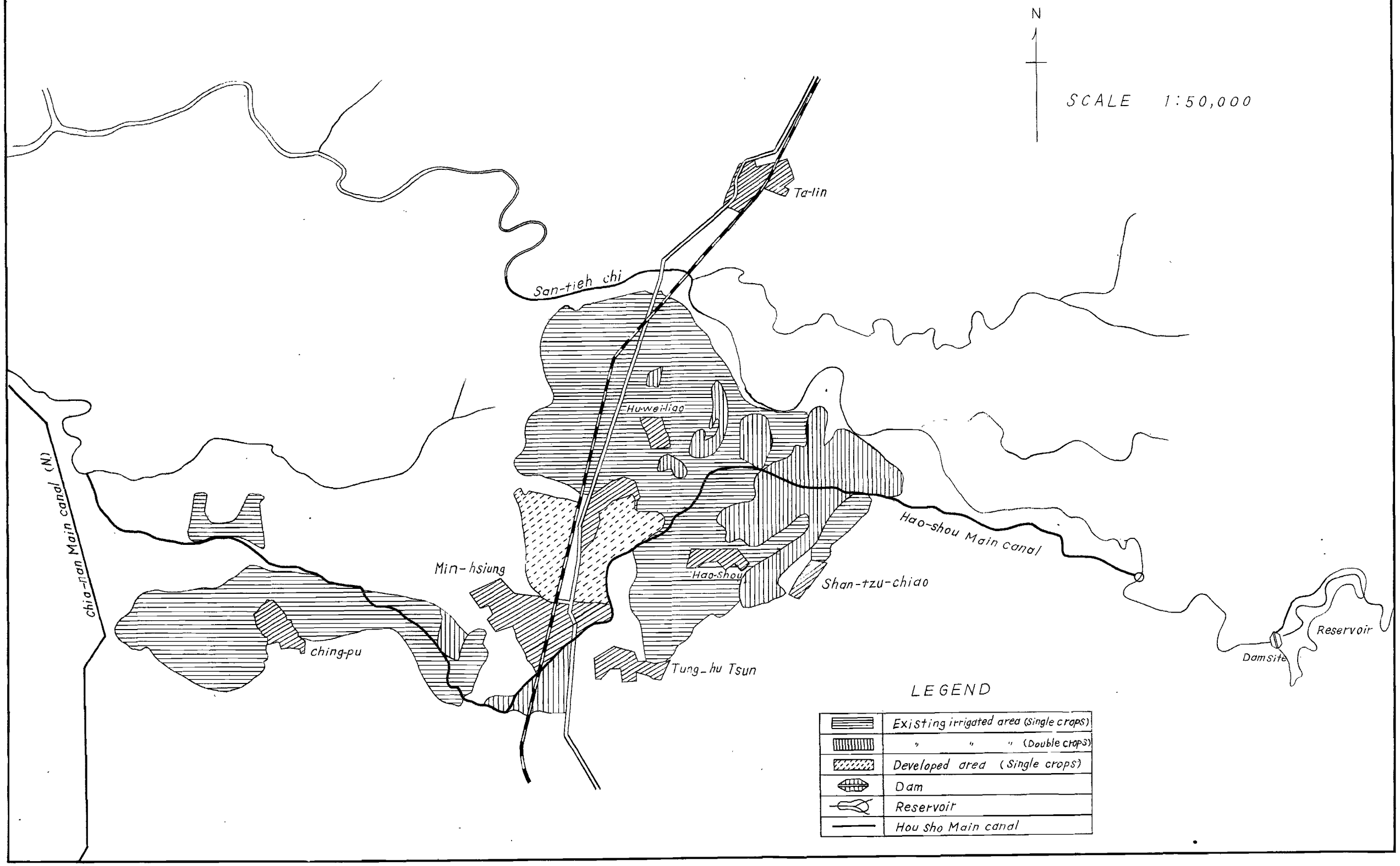

IRRIGATED AREA MAP
SCALE 1:50,000
0 500 1000 2000 m
N
To chia-yi
Tao Kung Shan Chi
Nei-lin
Hu-tz
Yuche-tien
Chi-tou
Ta-pu-mei
Lin-tzu-tou
Lin-tzu-chien
Ta-lin
Shui-tui
To Min-hsiung
Chung-lin
Sha-lun-tzu
Chung-keng
San Tieh Chi
Mei-hwa-tan Reservoir
Tunnel
Hsia-keng Reservoir

Fig 162

PLAN OF TIEN-LIAO RESERVOIR & IRRIGATED AREA



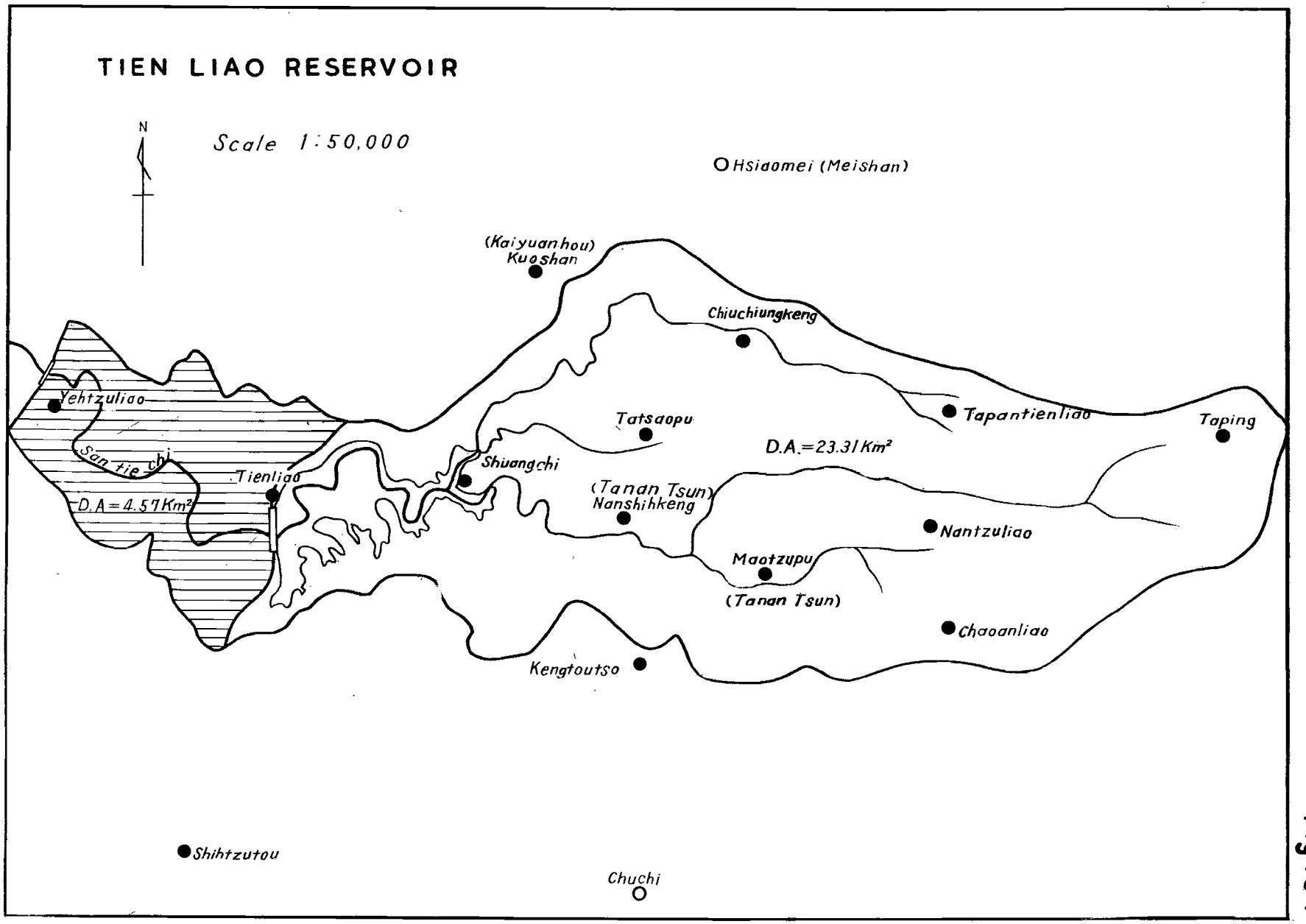

TIEN LIAO RESERVOIR
N
Scale 1:50,000
Hsiaomei (Meishan)
(Kaiyuanhou) Kuoshan
Chiuchiungkeng
Yehtzuliao
San tie chi
D.A=4.57Km²
Tienliao
Tatsaopu
Shuangchi
D.A.=23.31Km²
Tapantienliao
Taping
(Tanan Tsun) Nanshihkeng
Nantzuliao
Maotzupu
(Tanan Tsun)
Chaoanliao
Kengtoutso
Shihtzutou
Chuchi

Fig 164

Fig 165

CROSS SECTION AT DAM SITE

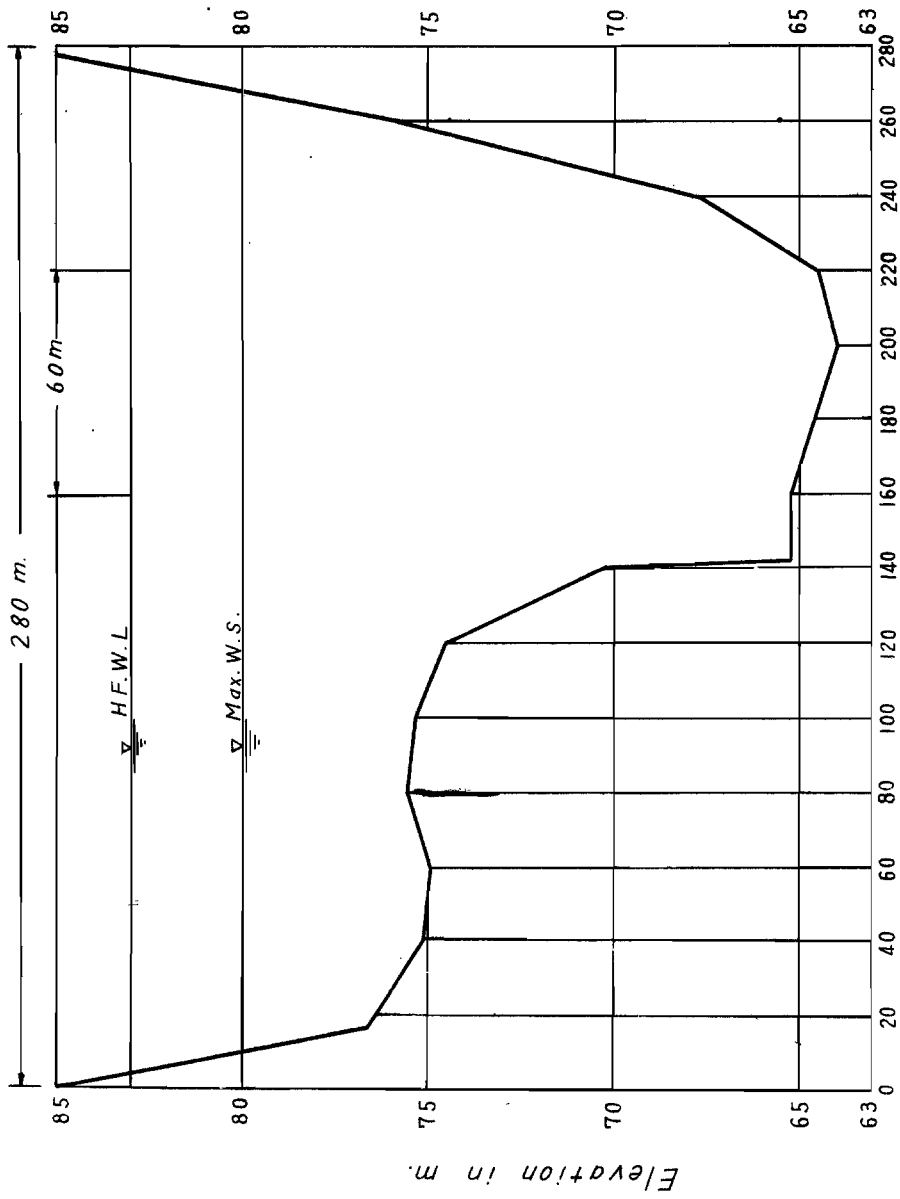
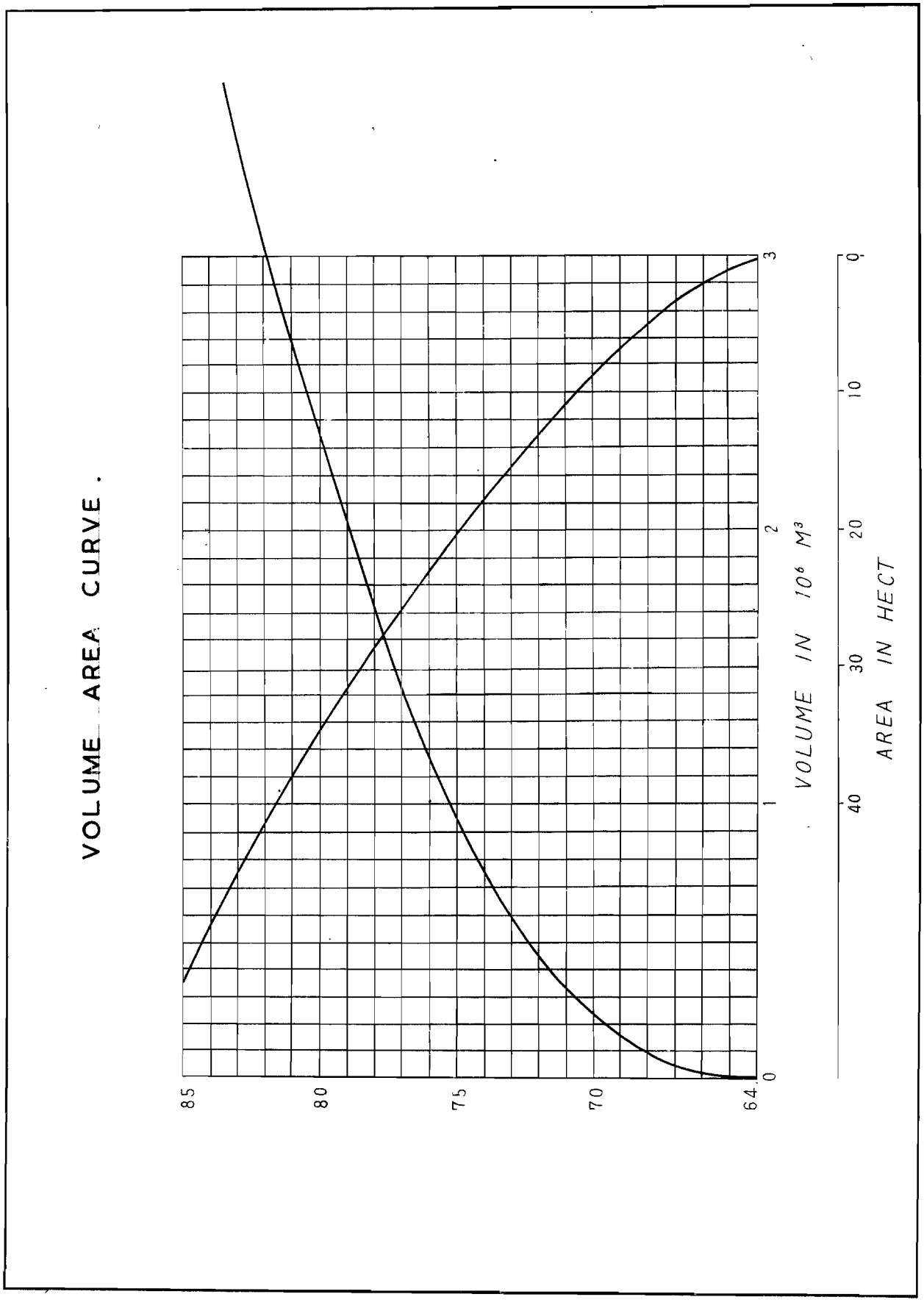
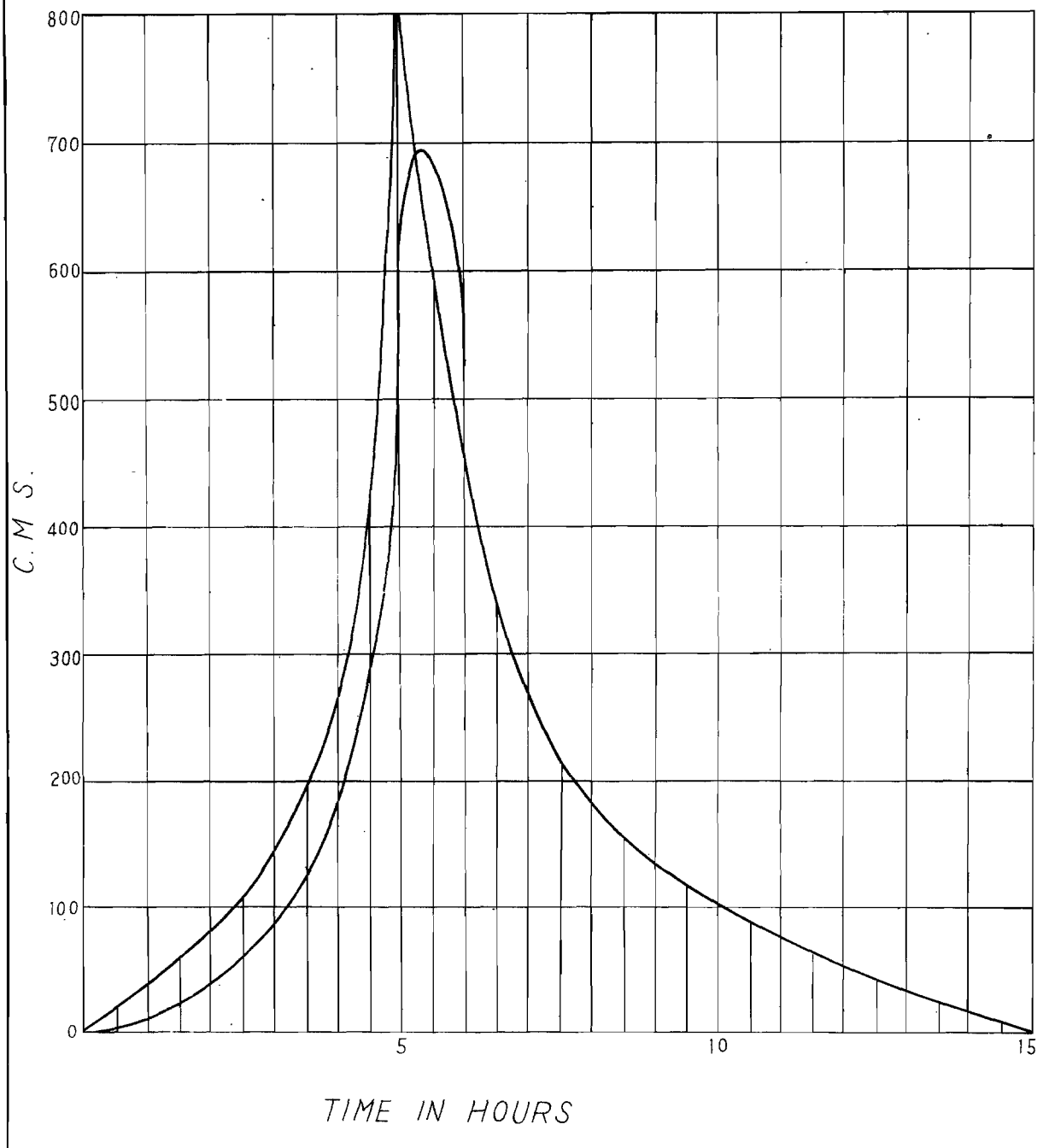


Fig166


VOLUME AREA CURVE.
85
80
75
70
64
0
1
2
3
VOLUME IN 10⁶ M³
0
10
20
30
40
AREA IN HECT

INFLOW OUTFLOW CURVE.



SPILLWAY DISCHARGE CURVE.

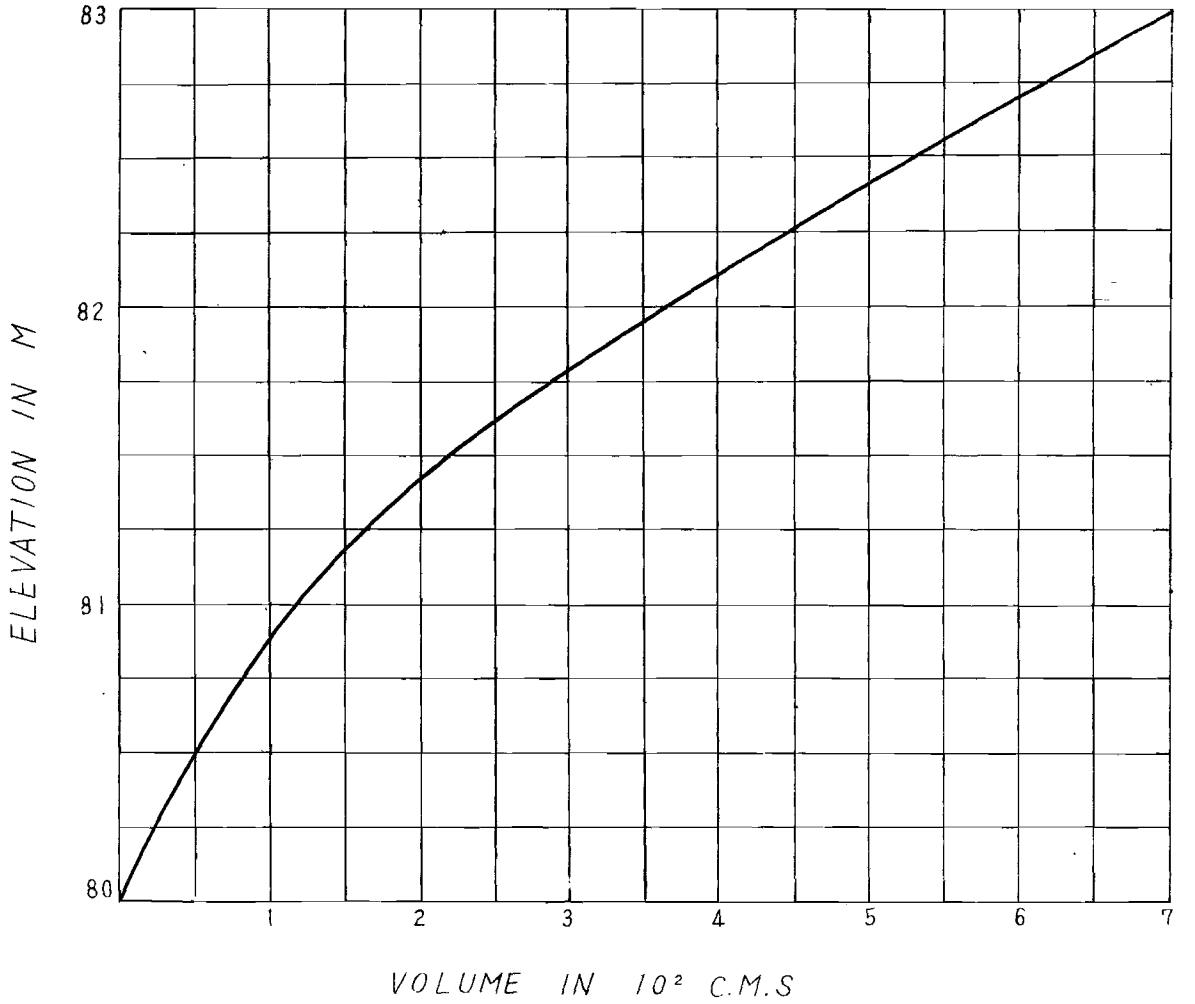


Fig 168

SPILLWAY DISCHARG CURVE

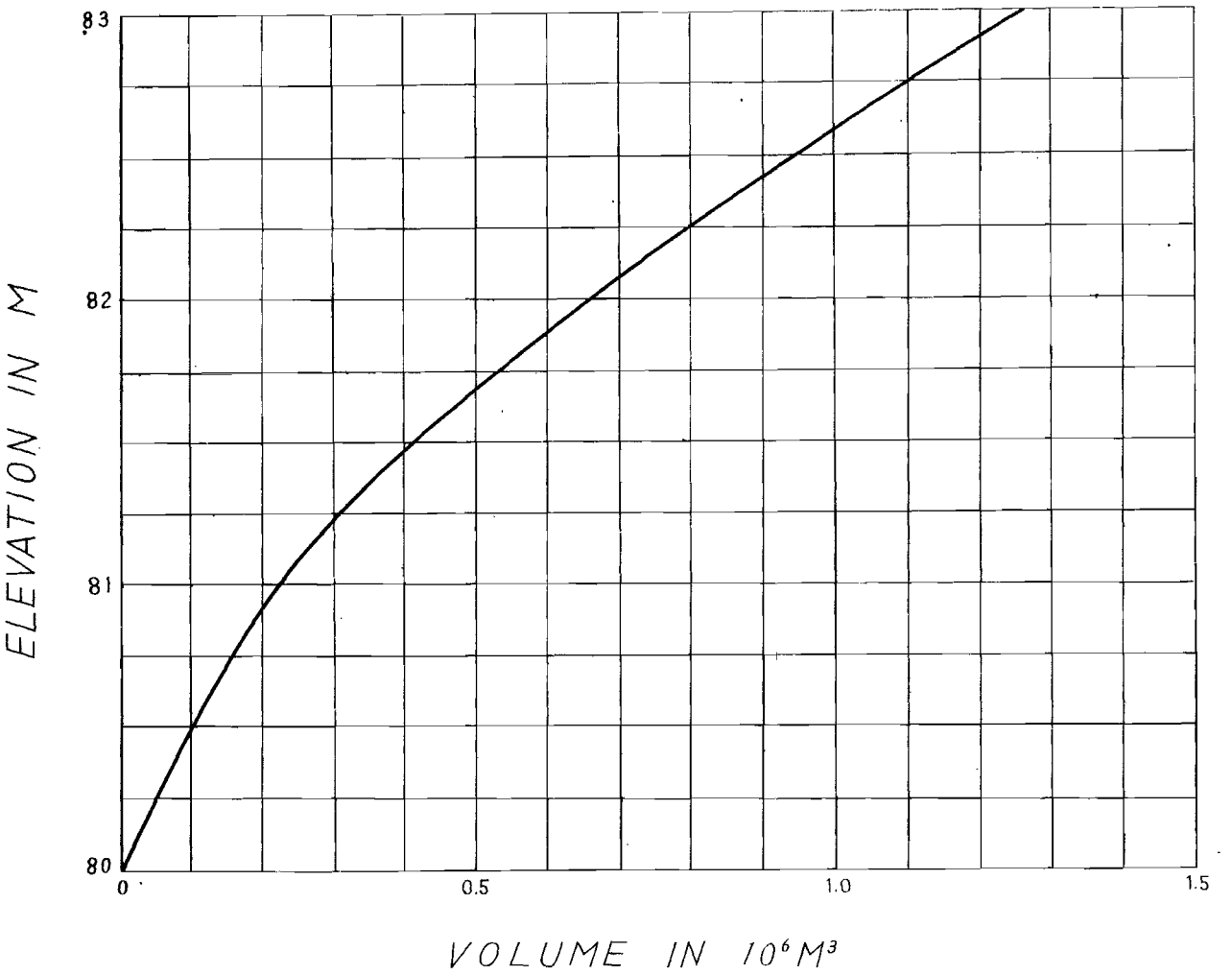
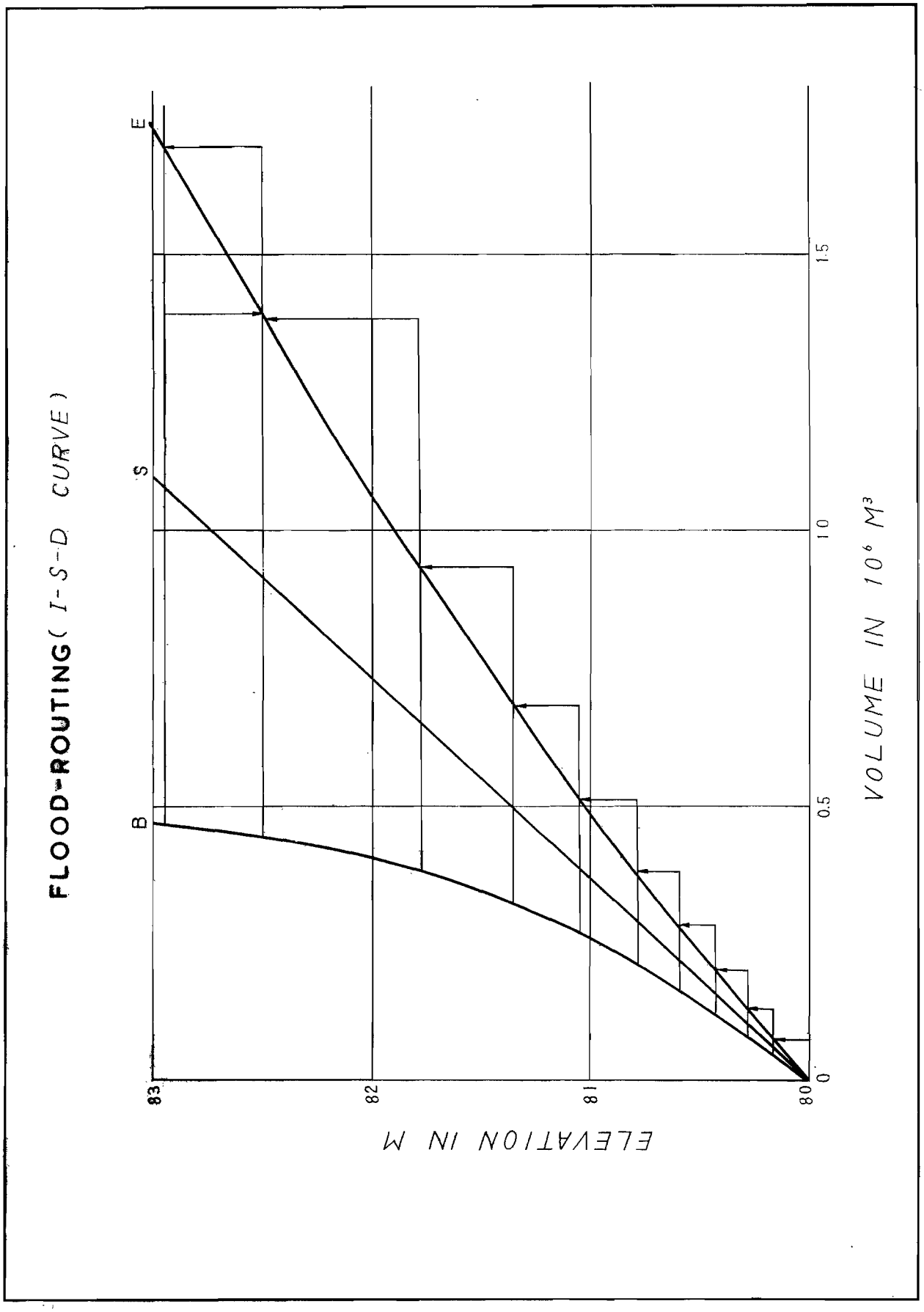


Fig 169

Fig 170


FLOOD-ROUTING (I-S-D CURVE)
E
S
B
83
82
81
80
ELEVATION IN M
0
0.5
1.0
1.5
VOLUME IN 10^6 M^3

TIEN-LIAO RESERVOIR
FLOOD-ROUTING COMPUTATION

STEP	1 TIME FROM BEGINNING OF FLOOD IN HOURS	2 INSTANTANEOUS RATE OF INFLOW INTO RESERVOIR, (I) IN C.M.S.	3 MEAN OF DISCHARGE AT BEGINNING AND END OF INTERVAL	4 VOLUME OF INFLOW INTO RESERVOIR DURING INTERVAL, CU. M.	5 RESERVOIR ELEVATION AT END OF INTERVAL IN M.	6 SPILLWAY DISCHARGE RATE AT END OF INTERVAL IN C.M.S.
1	0.5	20	10	18,000		
2	1.0	38	29	52,200	80.18	15
3	1.5	60	49	88,200	80.28	25
4	2.0	80	70	126,000	80.43	42.5
5	2.5	105	92.5	166,400	80.60	60
6	3.0	141	123	221,800	80.78	85
7	3.5	200	170.5	307,000	81.05	125
8	4.0	262	231	416,000	81.35	185
9	4.5	420	341	614,000	81.78	295
10	5.0	800	610	1,098,000	82.50	535
11	5.5	600	700	1,260,000	82.95	690
12	6.0	436	518	934,000	82.50	535

Fig 171

LOCATION MAP OF SHIHTZUTOU

S = 1 : 25,000

N

70

Shihtzutou

(Shihyeh Tsun)

Neiputzu

Lintzuwei

Ijen Tsun

Lutsowa

Chuchi

Tingsu

Kengtzuping

Chihsin

Niu

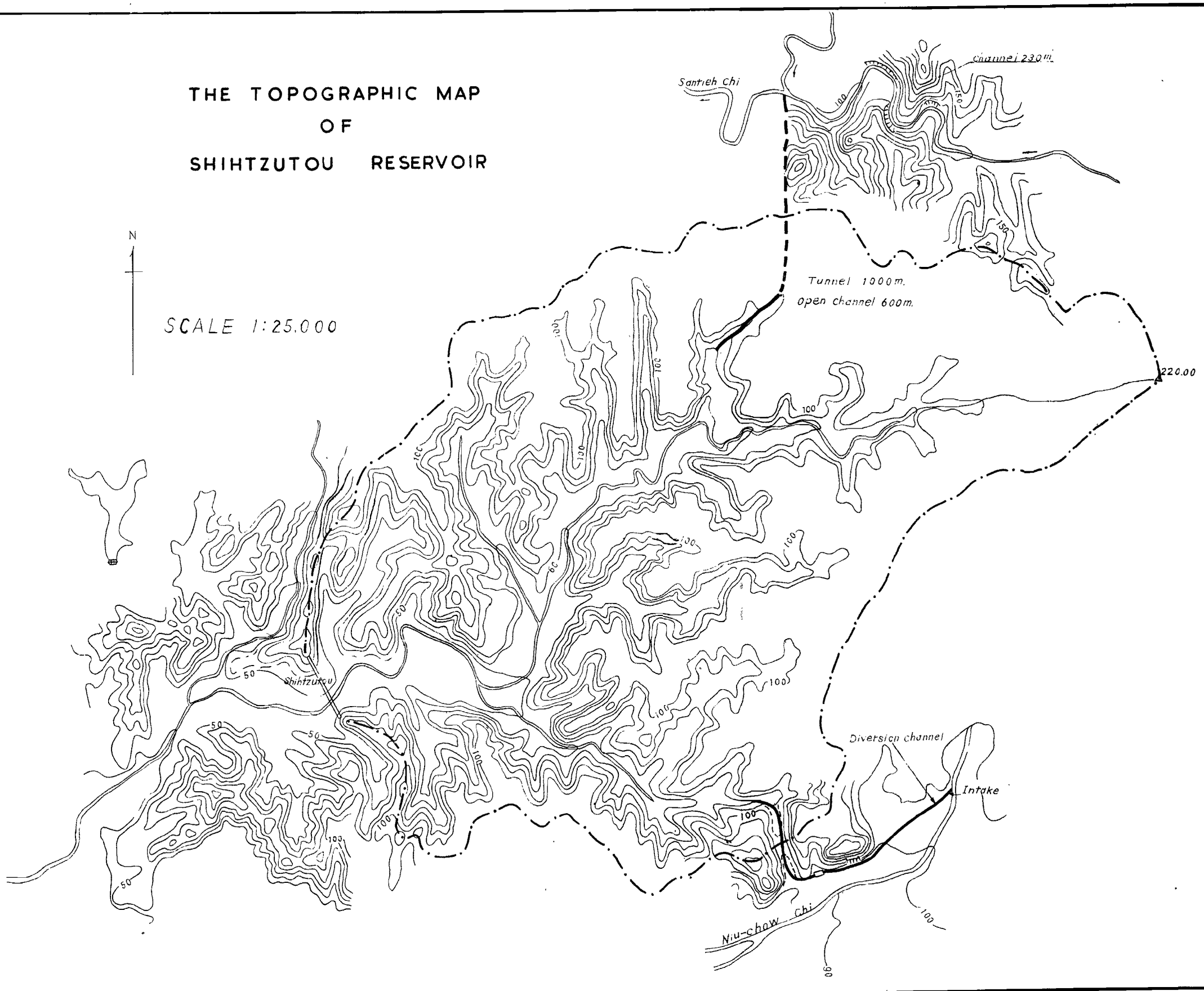
Chi

Chow

Potzupu

Lumachan

THE TOPOGRAPHIC MAP OF SHIHTZUTOU RESERVOIR



CROSS SECTION OF SHIHTZUTOU DAM SITE

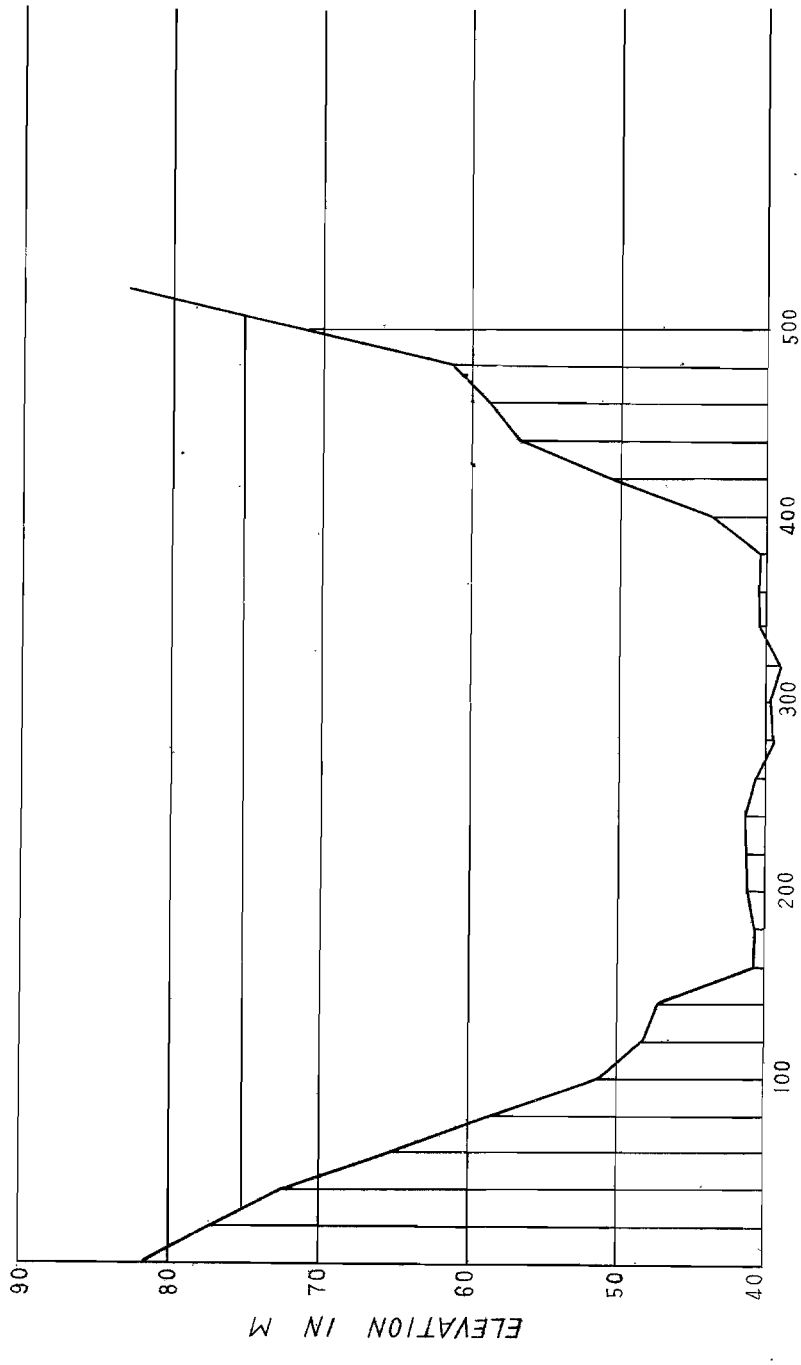
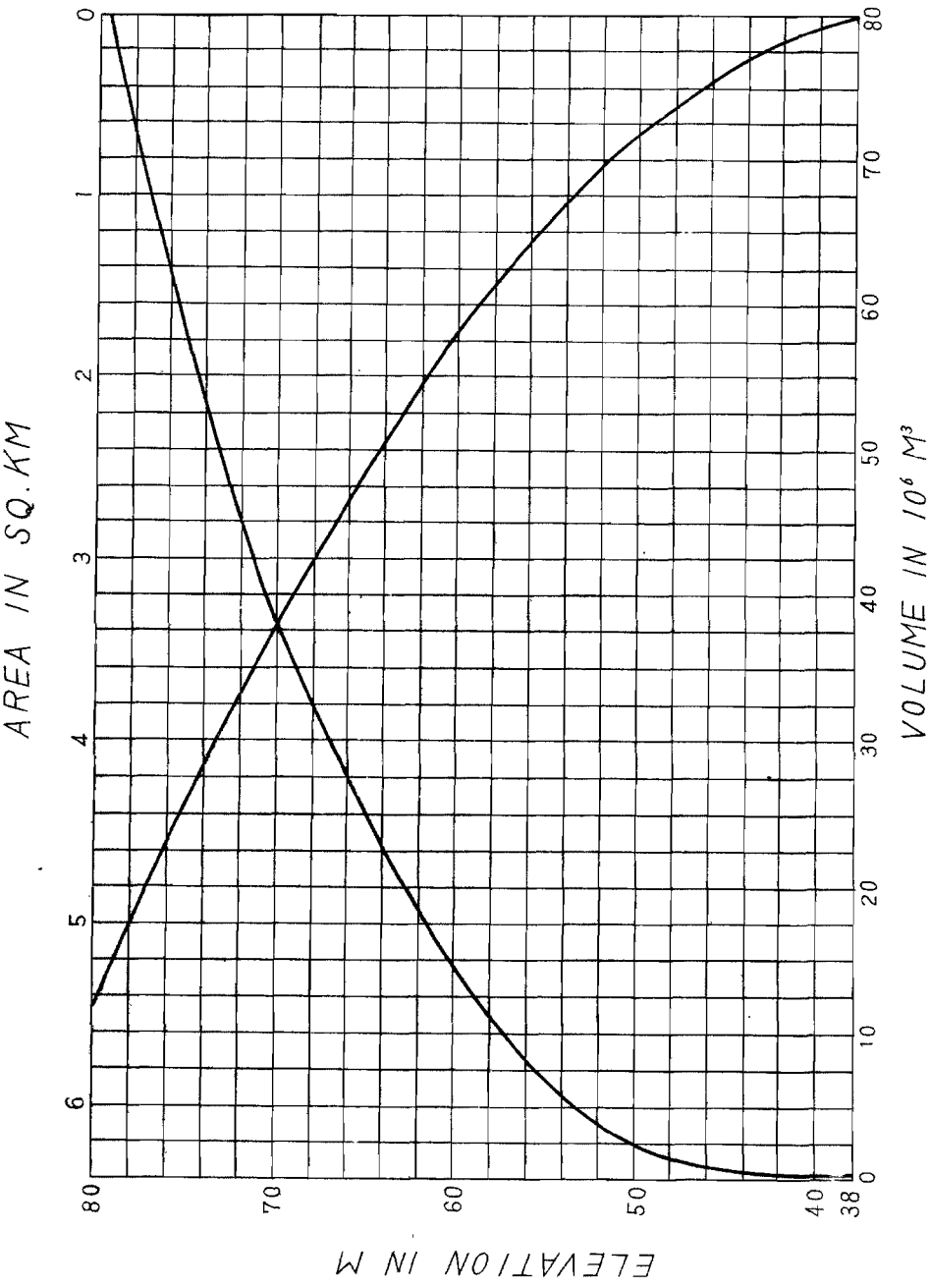


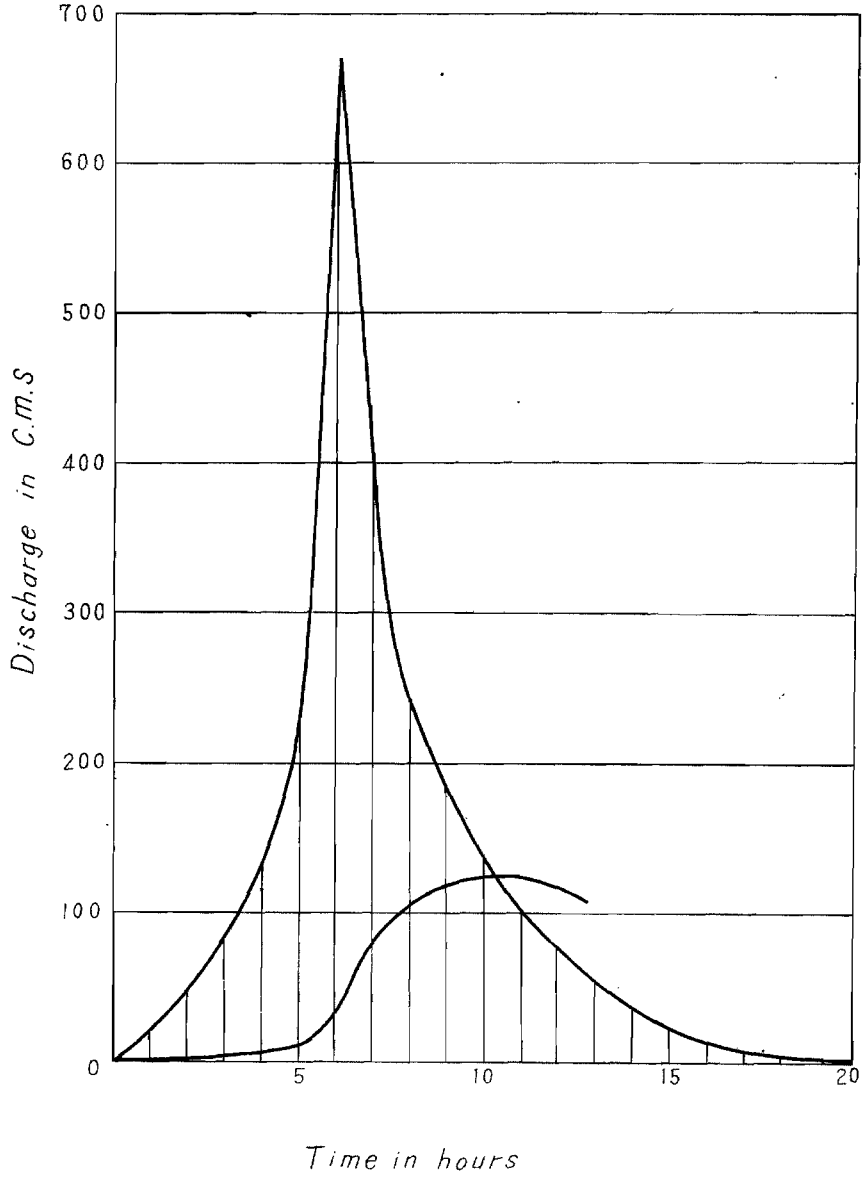
Fig 175

SHIHTZUTOU RESERVOIR

VOLUME – AREA CURVE



INFLOW – OUTFLOW CURVE



SPILLWAY DISCHARGE CURVE

Free flow straight Ogee crest
(No pier)
$Q = 2.21\ L\ (H)^{3/2}$
$Q = 125$ c m s design head $H = 1.6$ m
$L = 125/(2.21)(2.02) = 28 \fallingdotseq 30$ m

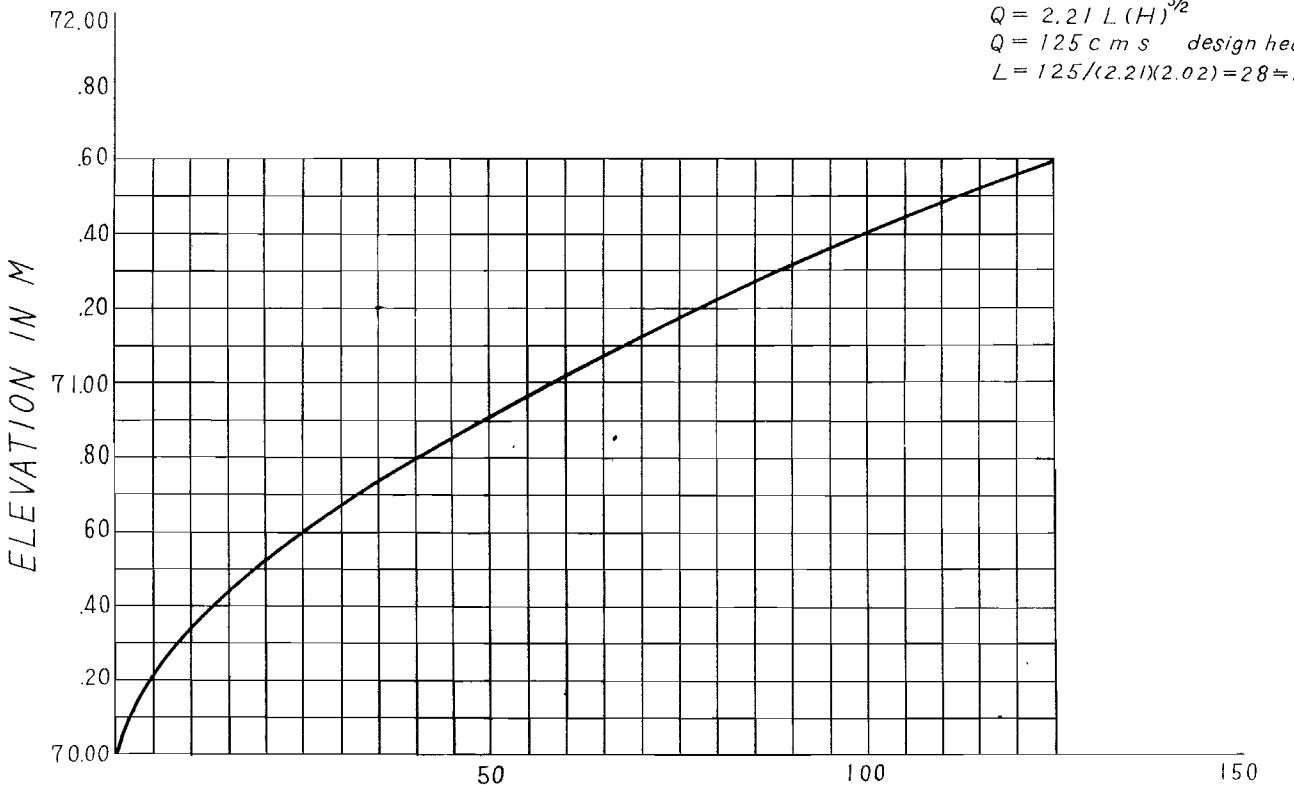
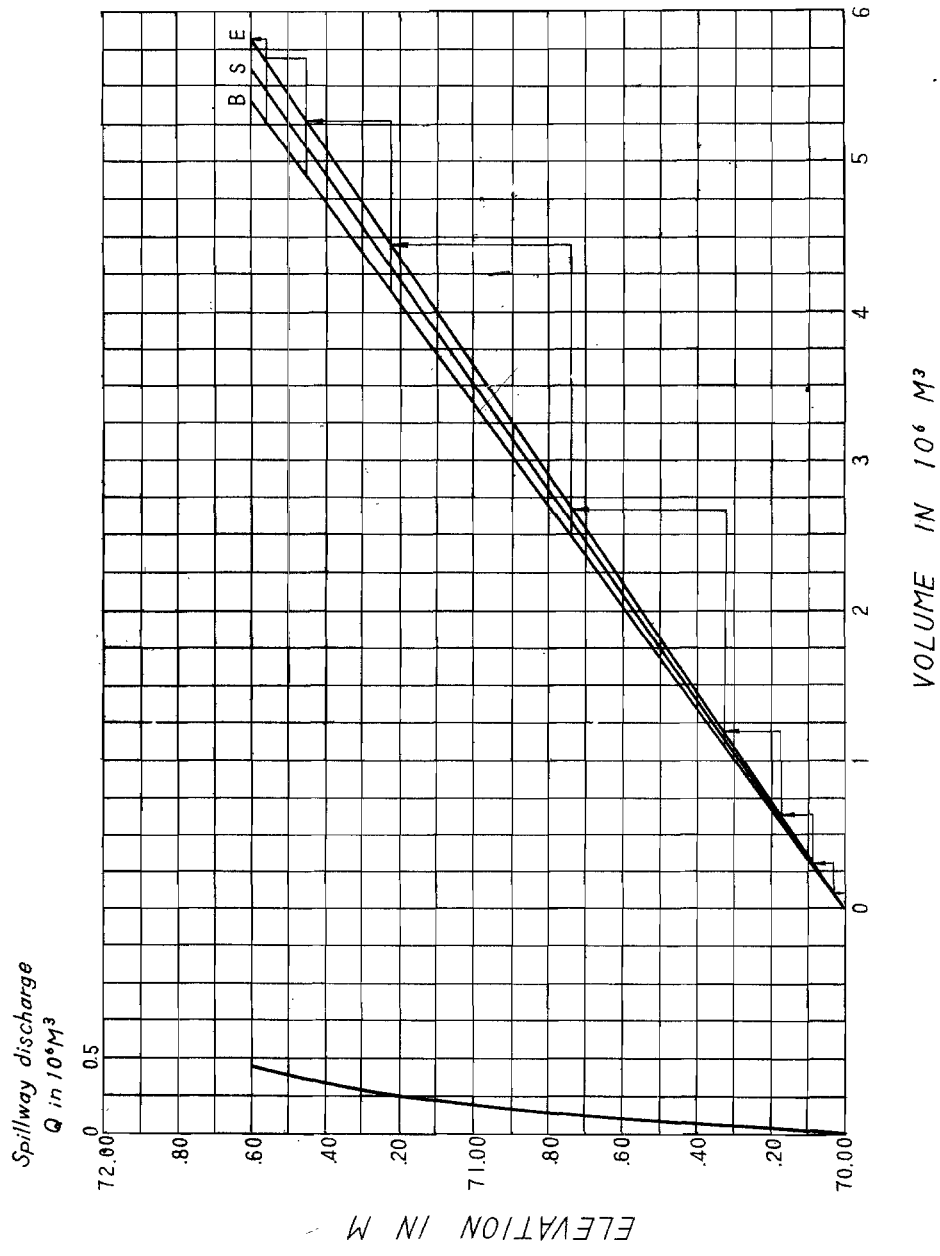


Fig 177

Fig 178

FLOOD-ROUTING

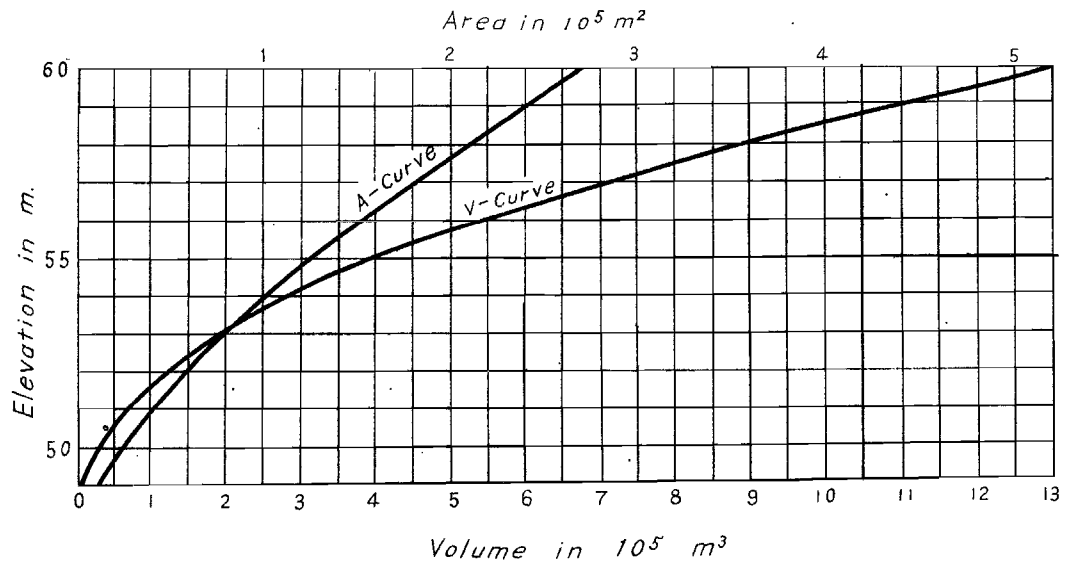


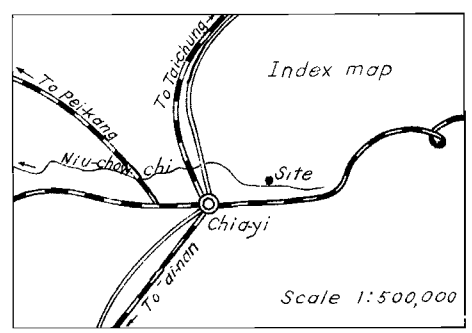
SHIH-TZU-TOU RESERVOIR
FLOOD-ROUTING COMPUTATION

STEP	(1) TIME FROM BEGINNING OF FLOOD IN HOURS	(2) INSTANTANEOUS RATE OF INFLOW INTO RESERVOIR (I) IN C.M.S.	(3) MEAN DISCHARGE AT BEGINNING AND END OF INTERVAL $1/2(I_1+I_2)$	(4) VOLUME OF INFLOW INTO RESERVOIR DURING INTERVAL IN C.M.S.	(5) RESERVOIR ELEVATION AT END OF INTERVAL	(6) SPILLWAY DISCHARGE RATE AT END OF INTERVAL IN C.M.S.
1	1	20	10	36,000		
2	2	45	32.5	118,800	70.02	1
3	3	80	62.5	225,000	70.08	1.5
4	4	130	105	378,000	70.17	3.5
5	5	220	175	630,000	70.32	9
6	6	670	445	1.600,000	70.74	35
7	7	400	535	1.925,000	71.22	80
8	8	250	325	1.170,000	71.46	108.5
9	9	180	215	774,500	71.56	121
10	10	140	160	575,800	71.60	125
11	11	100	120	432,000		
12	12	75	87.5	314,800		
13	13	51	63	226,500		
14	14	35	43	154,800		

Fig 179

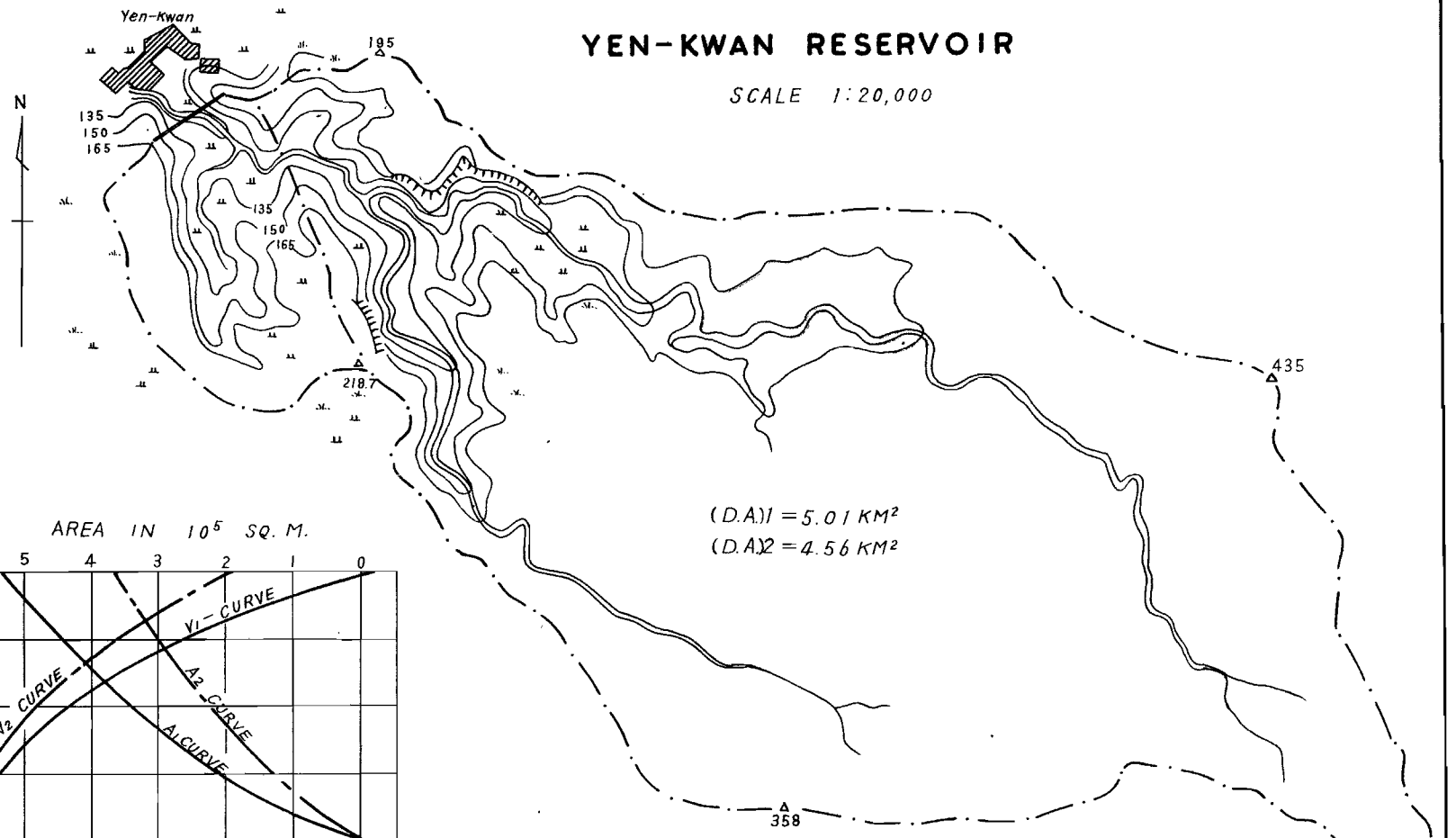
NEI - PU - TZU RESERVOIR





YEN-KWAN RESERVOIR

SCALE 1:20,000



ELE	D.A.1		D.A.2	
	AREA	VOLUME	AREA	VOLUME
128 M	- M²	- M³	- M²	- M³
130	8,000	8.000	-	-
135	212,000	558,000	132,000	330.000
150	534,000	6,153.000	368.000	4,080,000

CROSS SECTION

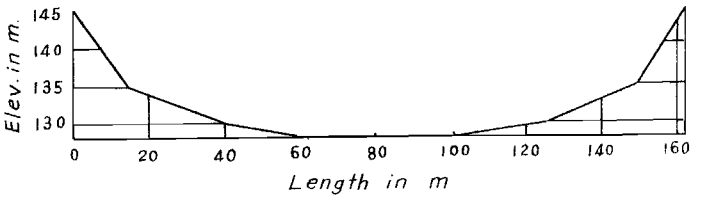


Fig 181

LU-LIAO RESERVOIR

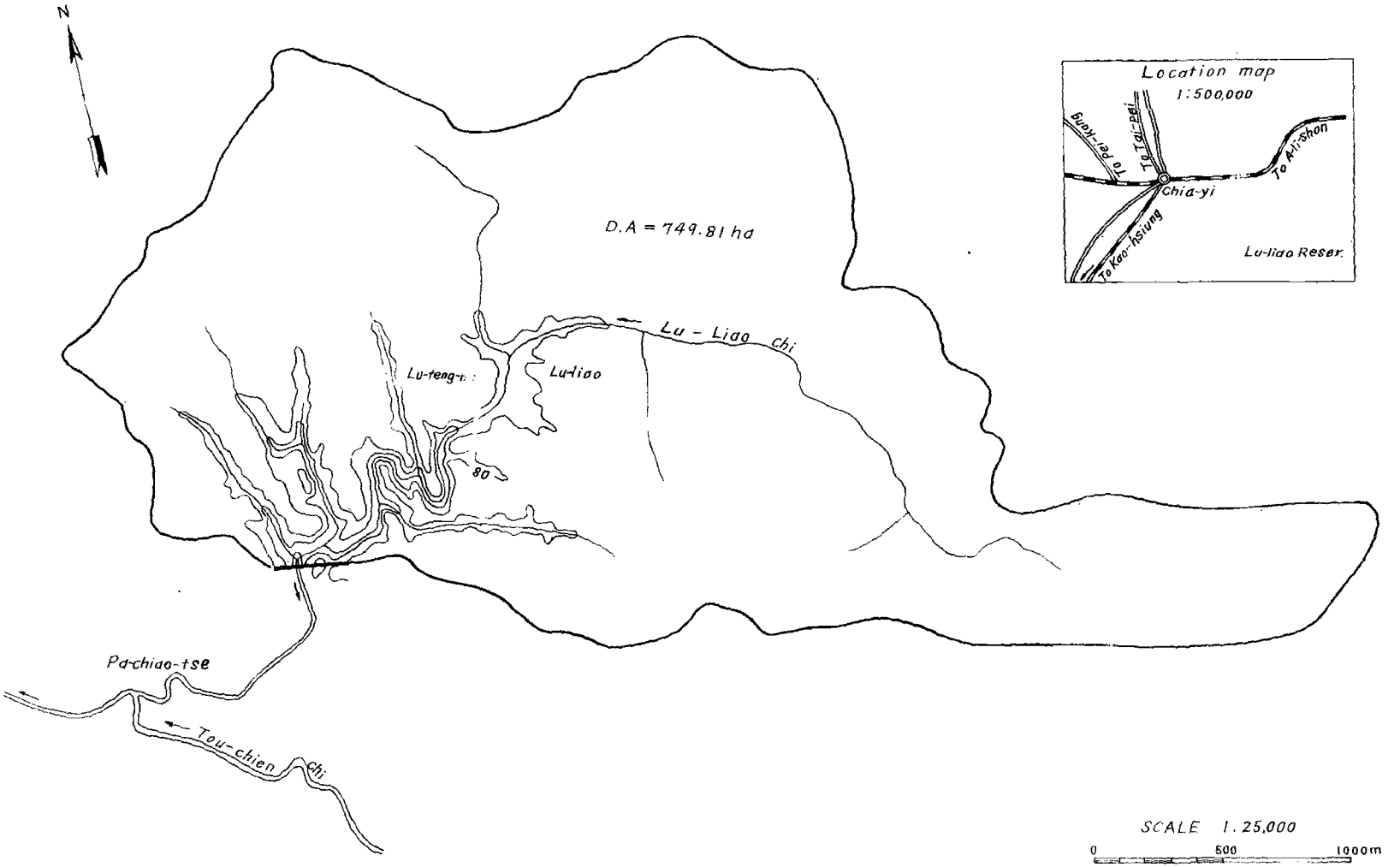
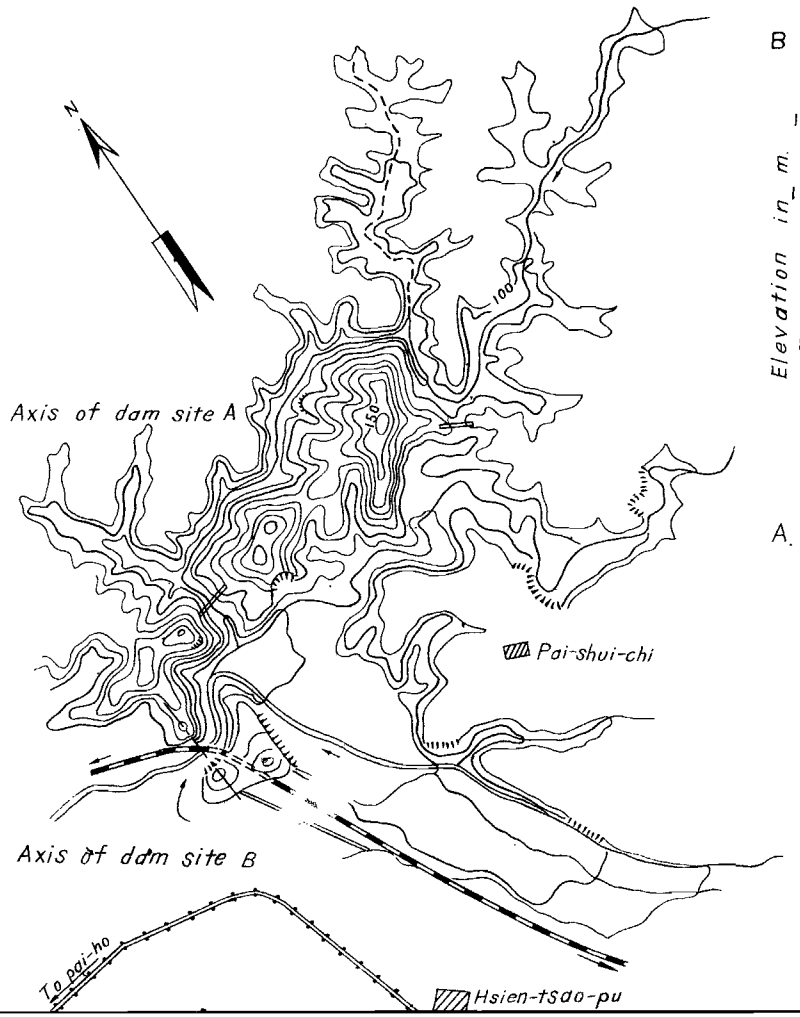


Fig 182

PAI-SHUI-CHI RESERVOIR

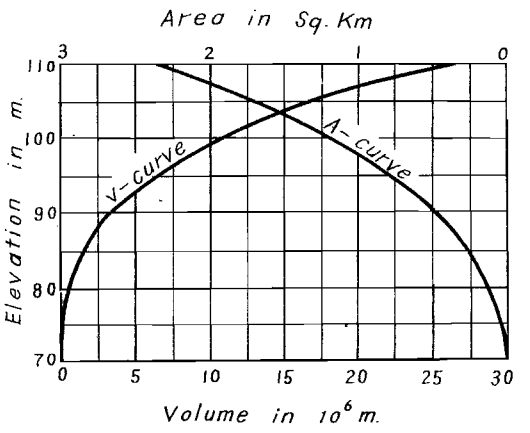
SCALE 1:25,000

0 500 1000 m



VOLUME-AREA CURVE

B



Elev. (m)	Area (Sq. Km)	Vol. (10^6 m^3)
110	2.31	25.58
100	1.18	10.86
90	0.46	3.06
80	0.08	0.38
70	——	——

A.

Elev. (m)	Area (Km^2)	Vol. (10^6 m^3)
110	0.80	8.30
100	0.34	2.60
90	0.09	0.45
80	—	—

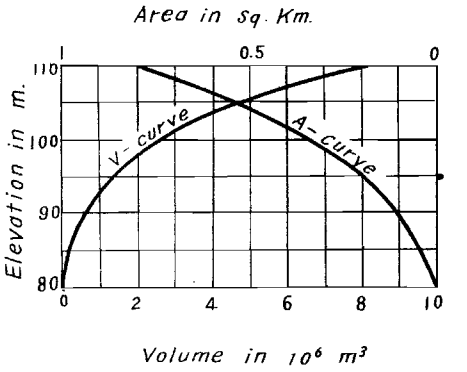
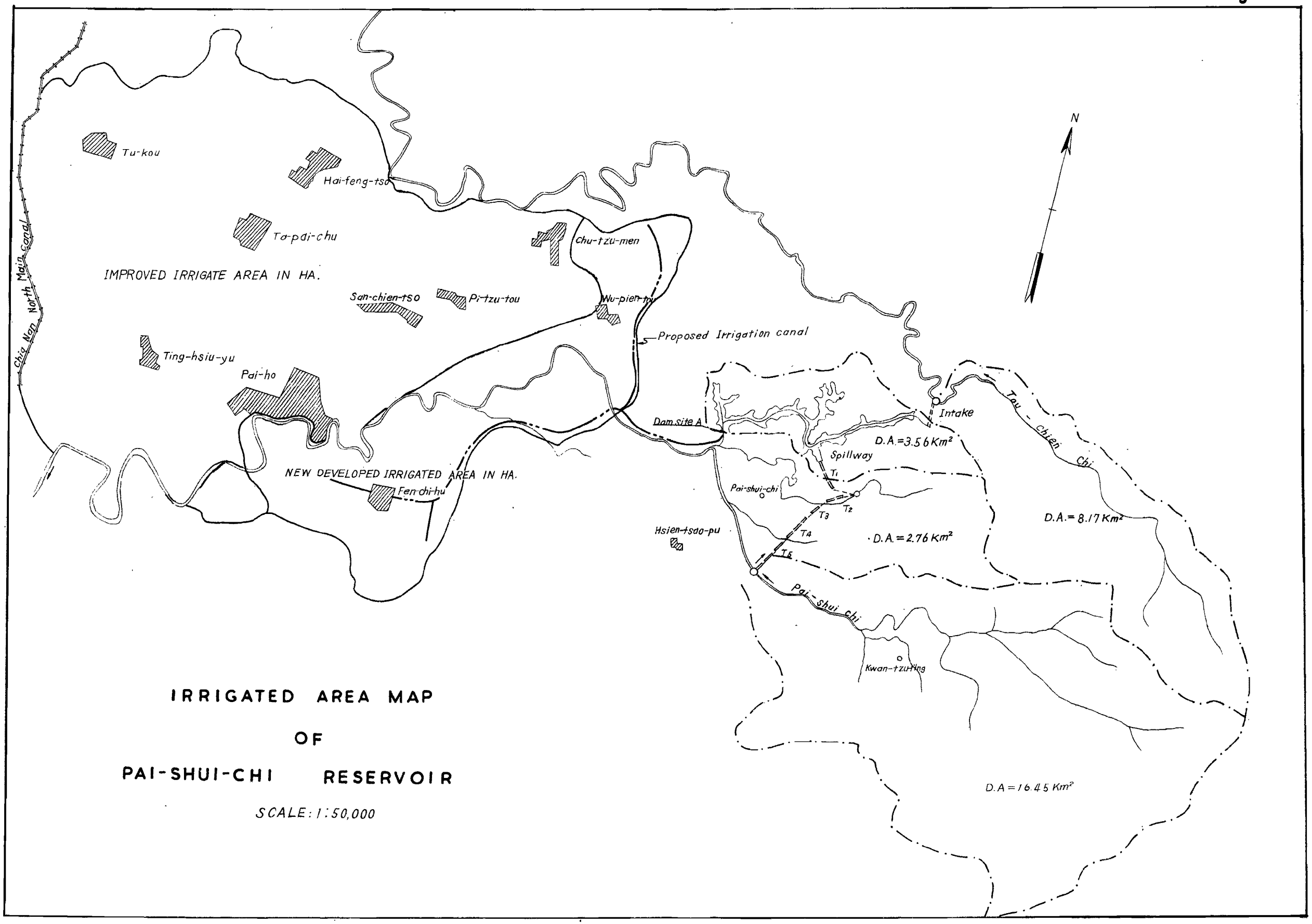


Fig 183



IRRIGATED AREA MAP

OF

PAI-SHUI-CHI RESERVOIR

SCALE: 1:50,000

LOCATION MAP OF DAM SITE

Scale 1:5,000

50 0 100 m.

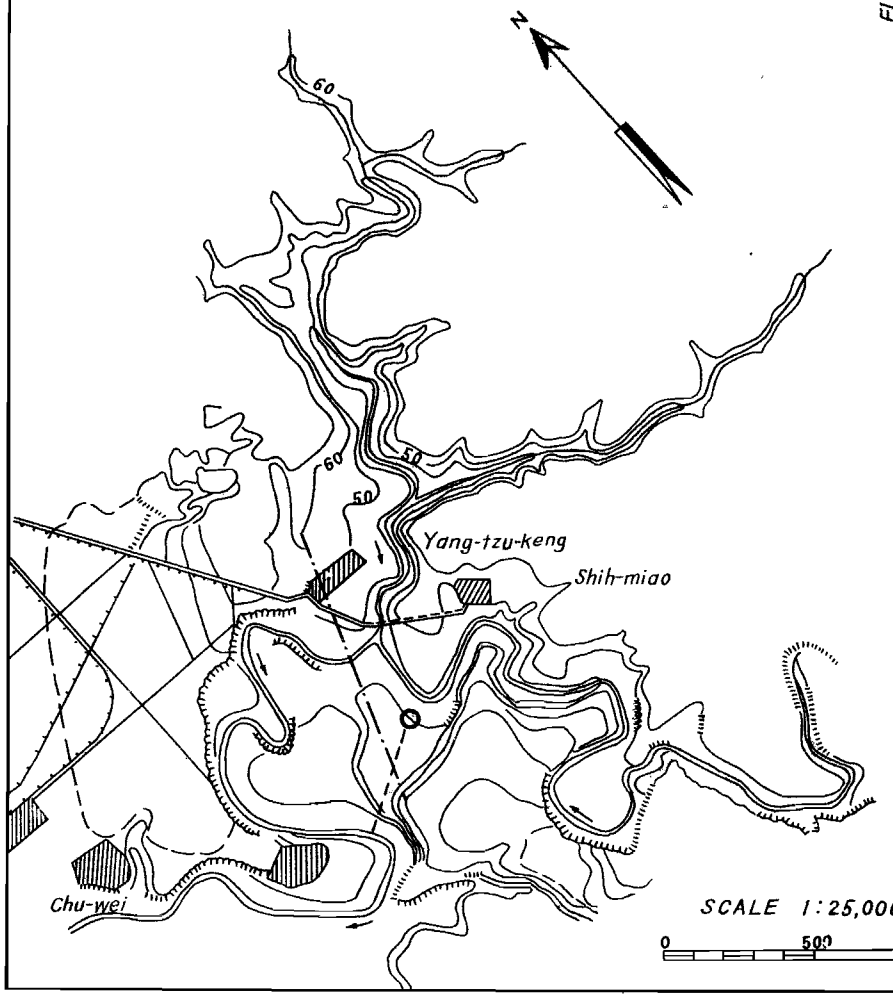
Dam Site A

Dam Site B

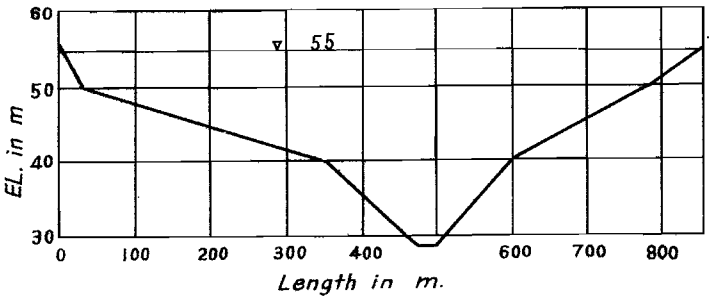
To Paiho

To Hsieh-tsao

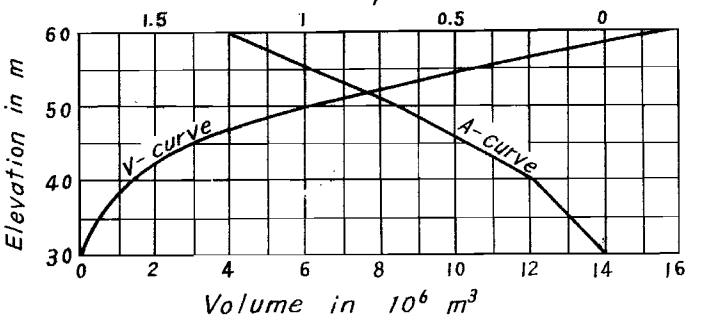
LIU-CHUNG RESERVOIR



CROSS SECTION



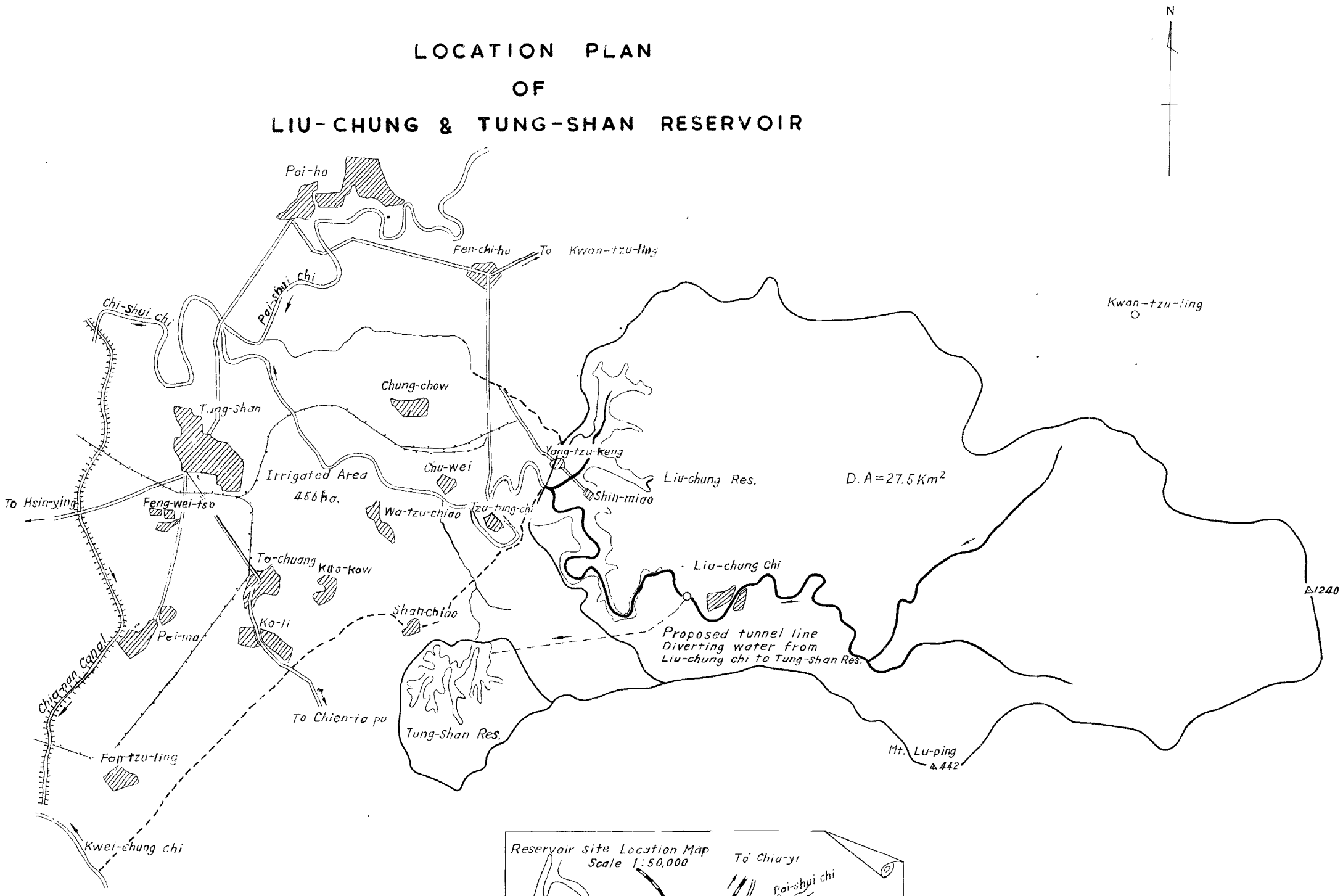
VOLUME – AREA CURVE



Elev. (m)	Area ($10^6 m^2$)	Vol. ($10^6 m^3$)
60	1.25	15.68
50	0.69	5.98
40	0.23	1.38
30	—	—

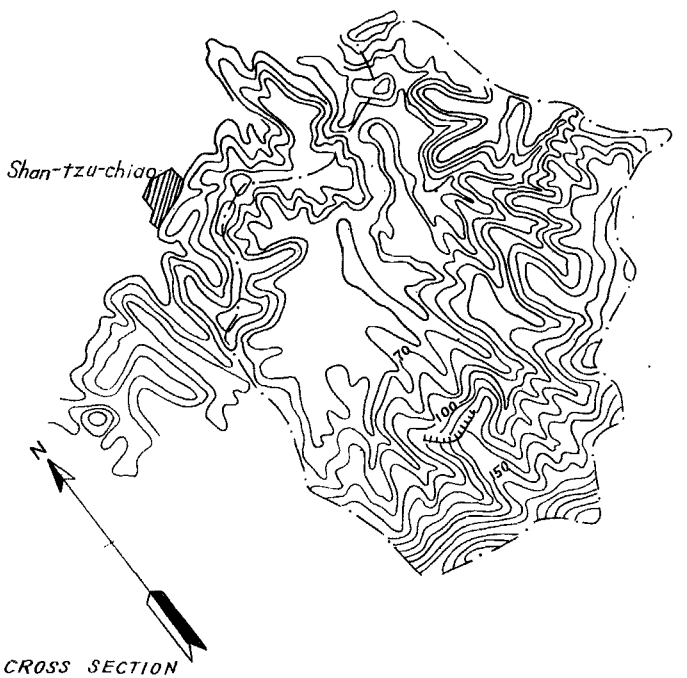
Fig 186

LOCATION PLAN
OF
LIU-CHUNG & TUNG-SHAN RESERVOIR

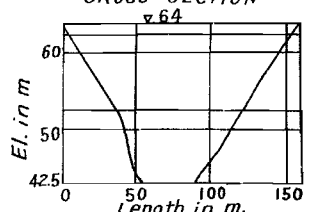


Scale: 1:25,000

TUNG-SHAN RESERVOIR



CROSS SECTION



SCALE 1:25,000

0 500 1,000 m.

VOLUME—AREA CURVE

Elev. (m)	Area (hect.)	Vol. ($10^5 m^3$)
62	38.40	21.92
61	35.00	18.25
60	31.51	14.92
55	11.51	4.17
50	2.07	0.77
42.5	—	—

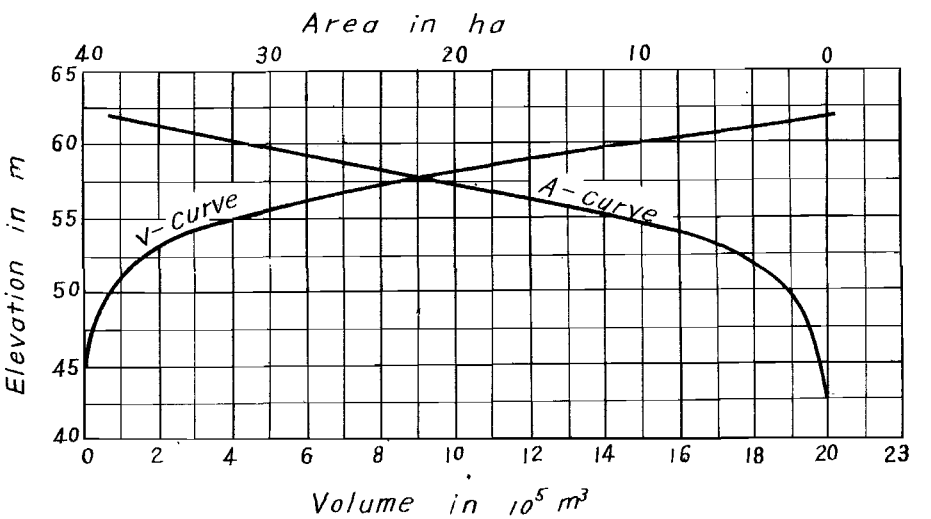


Fig 188

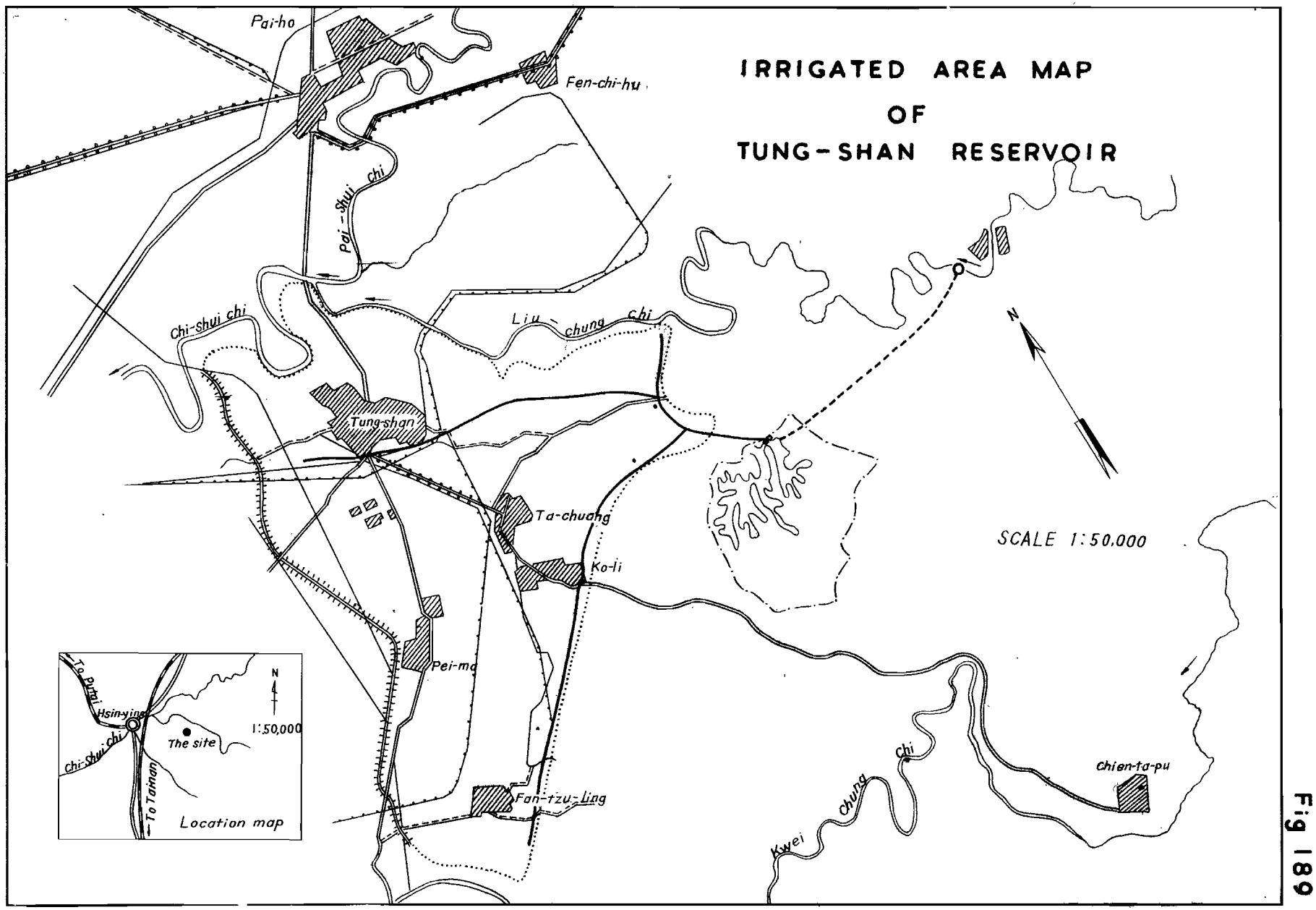
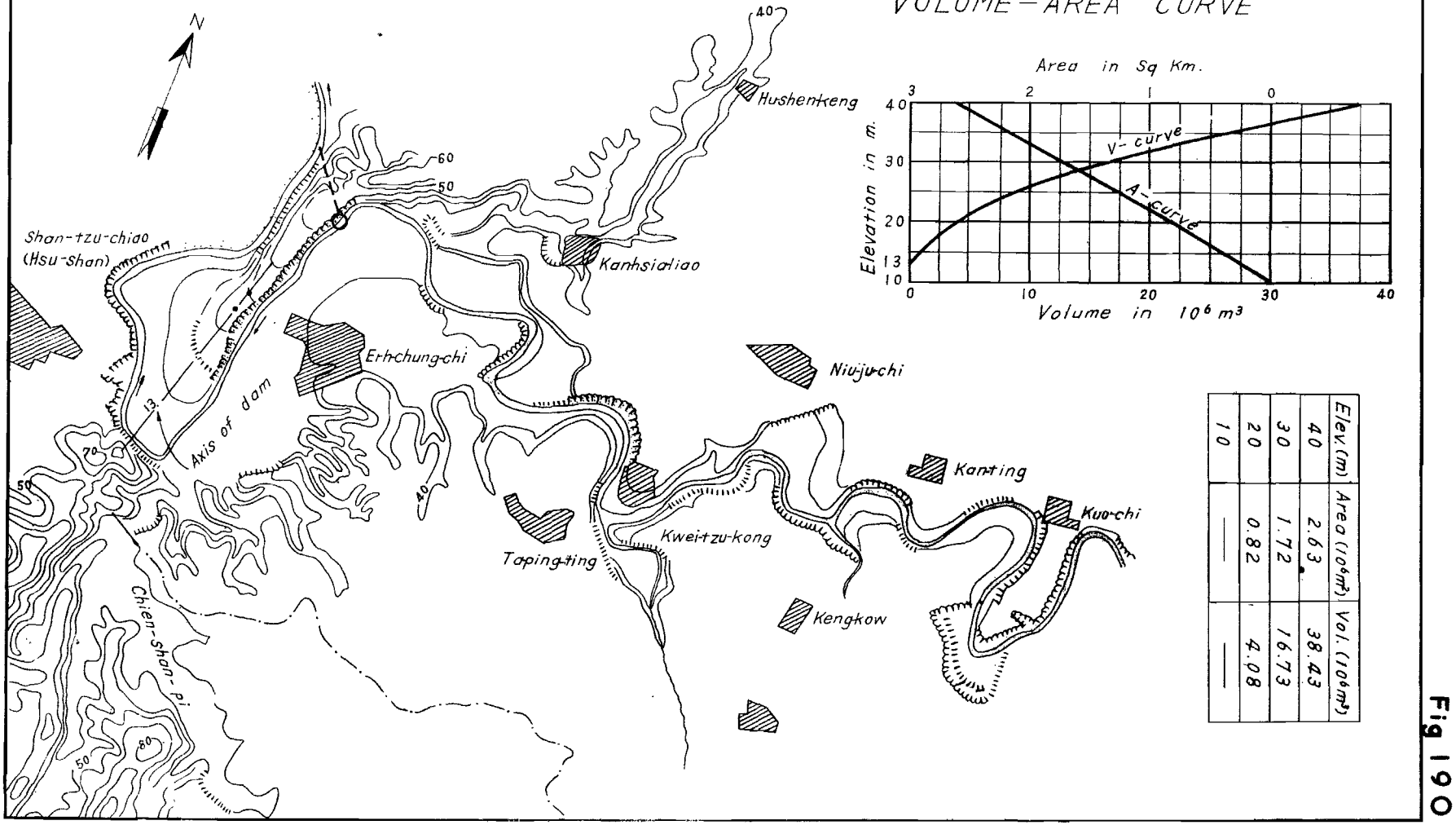

IRRIGATED AREA MAP
OF
TUNG-SHAN RESERVOIR
Pai-ho
Fen-chi-hu
Pai-Shui Chi
Chi-shui chi
Liu-chung Chi
Tung-shan
Ta-chuang
Ko-li
Pei-ma
Fan-tzu-ling
Kwei Chung Chi
Chien-ta-pu
N
SCALE 1:50,000
To Pa-tai
Hsin-ying
Chi-Shui chi
To Tainan
The site
1:50,000
Location map

Fig 189

KWEI - CHUNG RESERVOIR

SCALE 1:25,000

0 500 1000 m

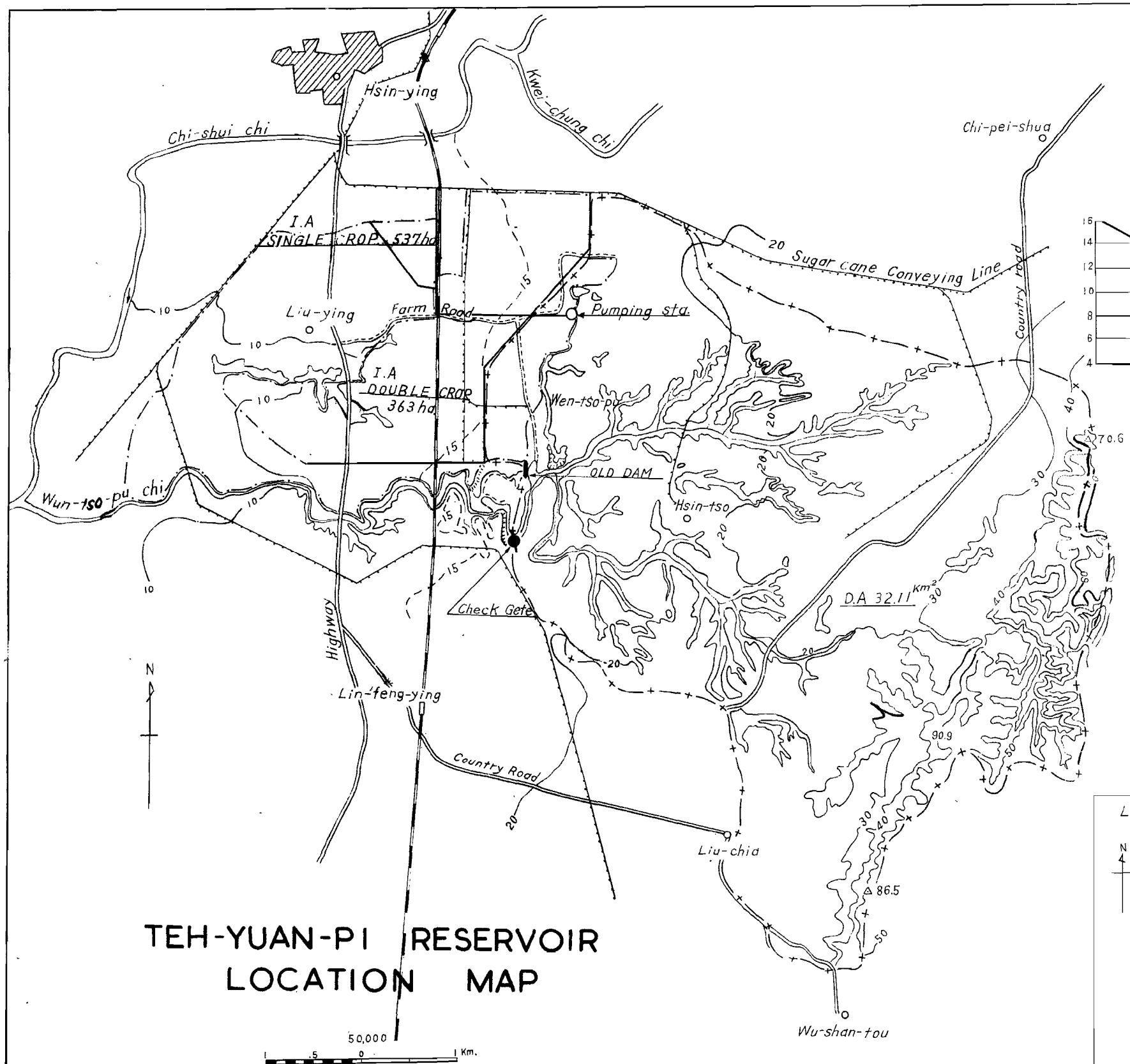


VOLUME – AREA CURVE

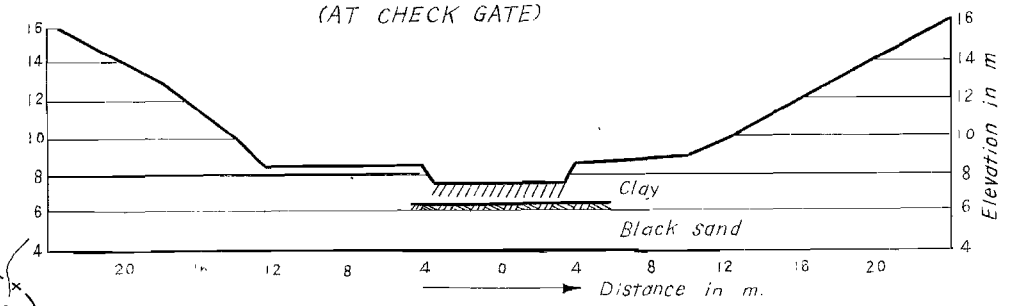
Elev.(m)	Area ($10^6 m^2$)	Vol. ($10^6 m^3$)
40	2.63	38.43
30	1.72	16.73
20	0.82	4.08
10	——	——

Fig 190

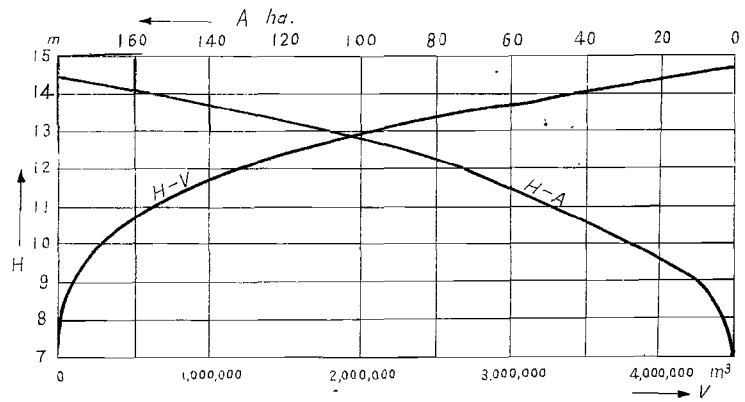
TEH-YUAN-PI RESERVOIR LOCATION MAP



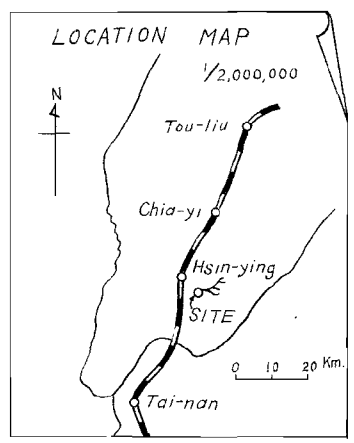
SITE SECTION
(AT CHECK GATE)



CAPACITY CURVE



LOCATION MAP



AREA CAPACITY TABLE

El	A ha.	V m³
7	0.3	800
8	2.5	15,100
9	9.4	74,500
10	26.6	254,400
11	48.3	629,700
12	72.6	1,197,200
13	109.2	2,100,000
14	153.9	3,409,000
14.5	175.4	4,231,800

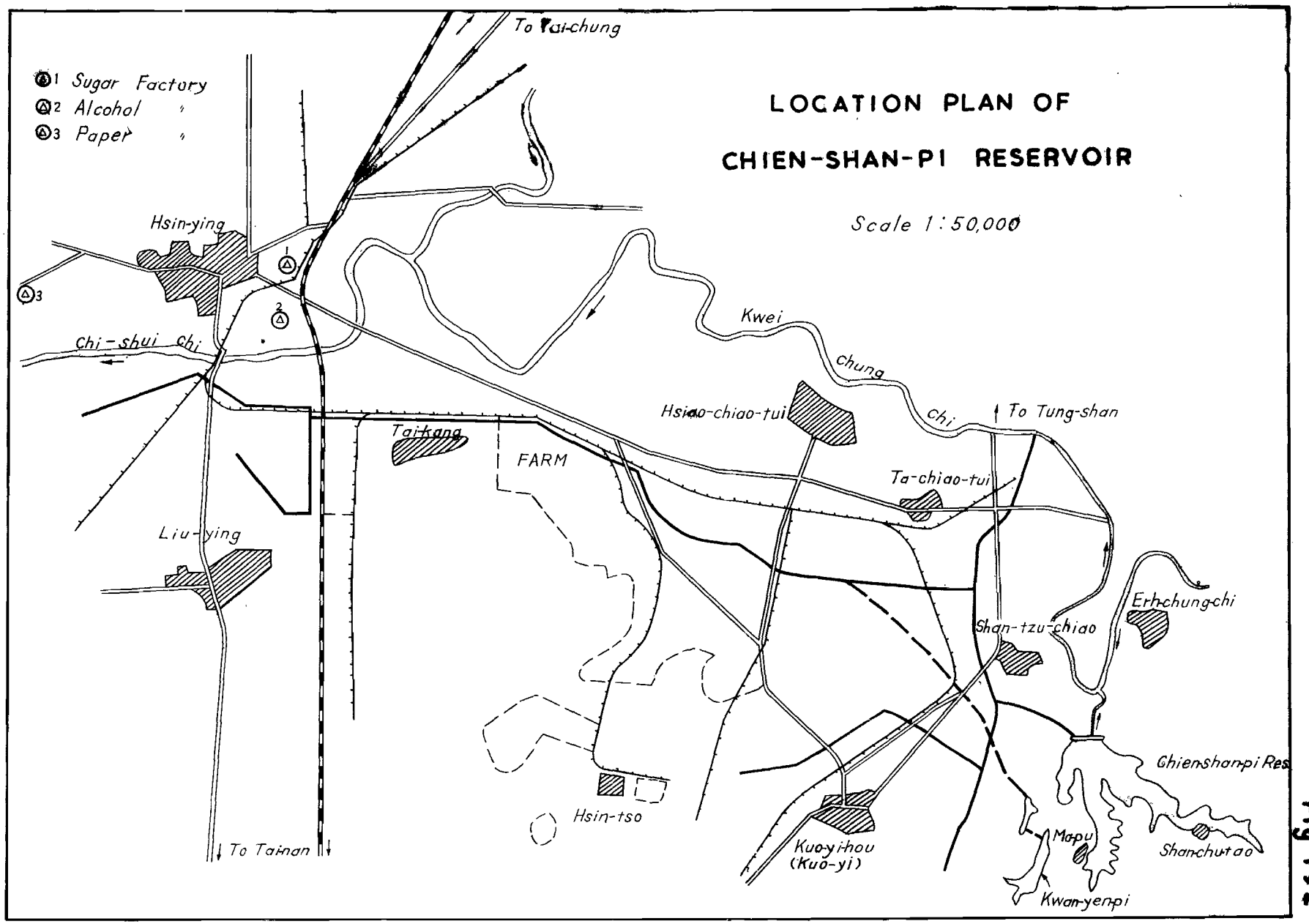
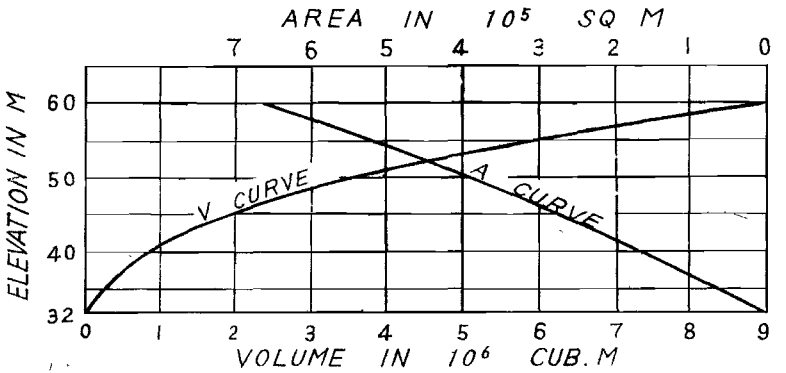

LOCATION PLAN OF
CHIEN-SHAN-PI RESERVOIR
Scale 1:50,000
1 Sugar Factory
2 Alcohol "
3 Paper "
To Tai-chung
Hsin-ying
Chi-shui Chi
Kwei
chung
chi
To Tung-shan
Hsiao-chiao-tui
Tai-kang
FARM
Ta-chiao-tui
Liu-ying
Erh-chung-chi
Shan-tzu-chiao
Chienshanpi Res.
Hsin-tso
To Tainan
Kuo-yi-hou
(Kuo-yi)
Mapu
Shan-chu-tao
Kwan-yen-pi

Fig 192

NAN-HU RESERVOIR



ELE.	AREA	VOLUME
32 M		
40.	175,000	700,000
50	393,750	3,543,750
60	656,250	8,793,750

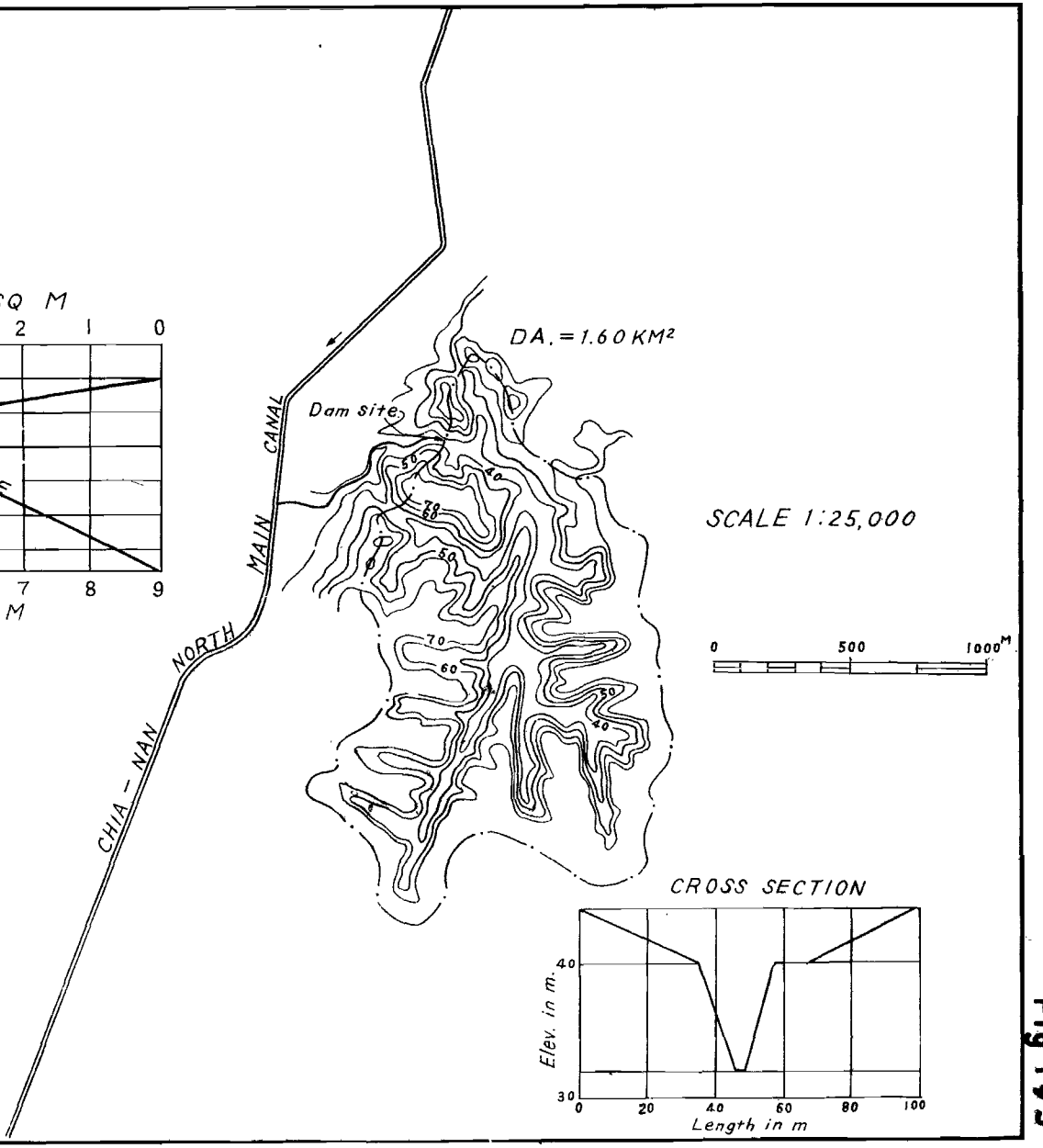


Fig 193

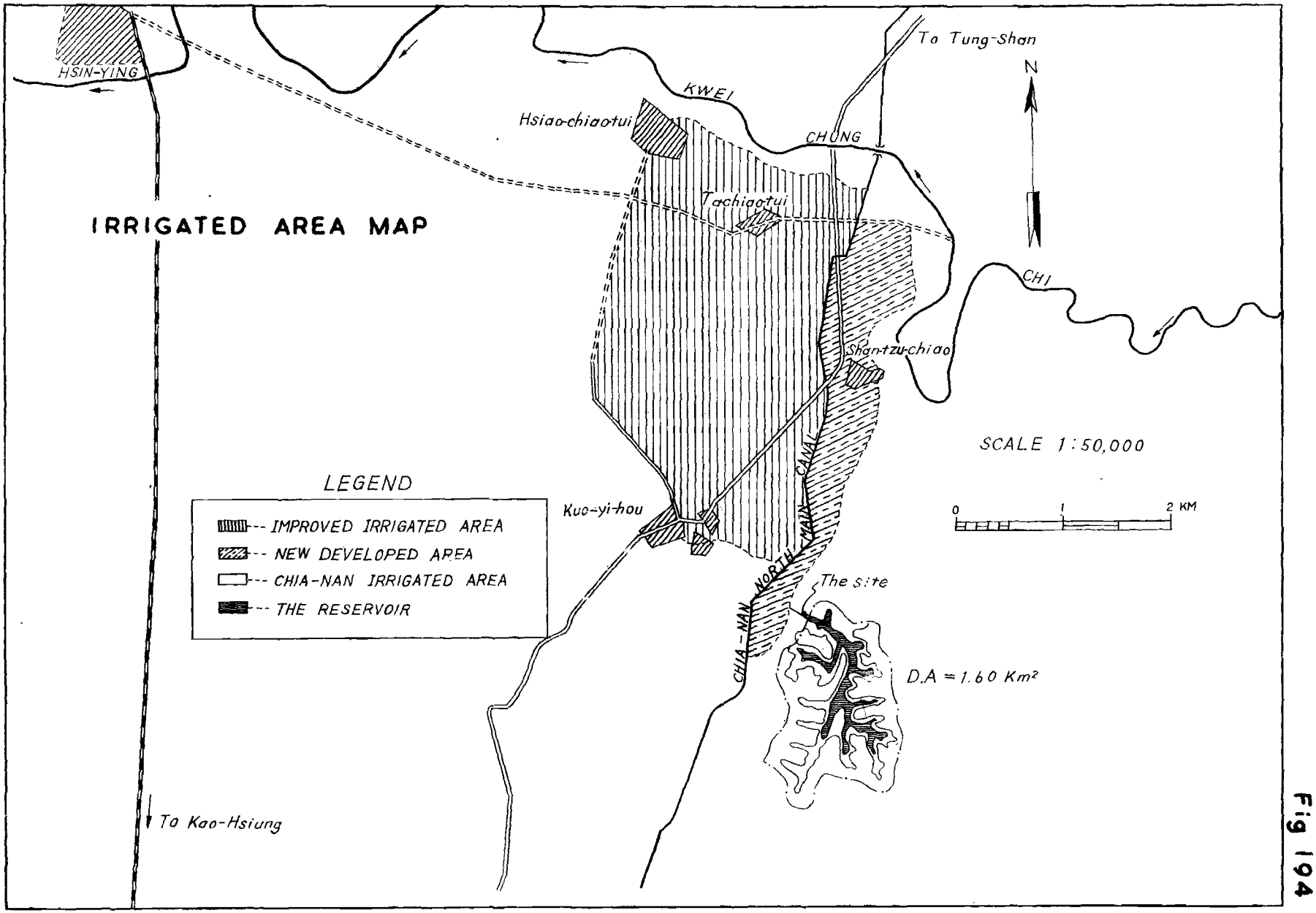
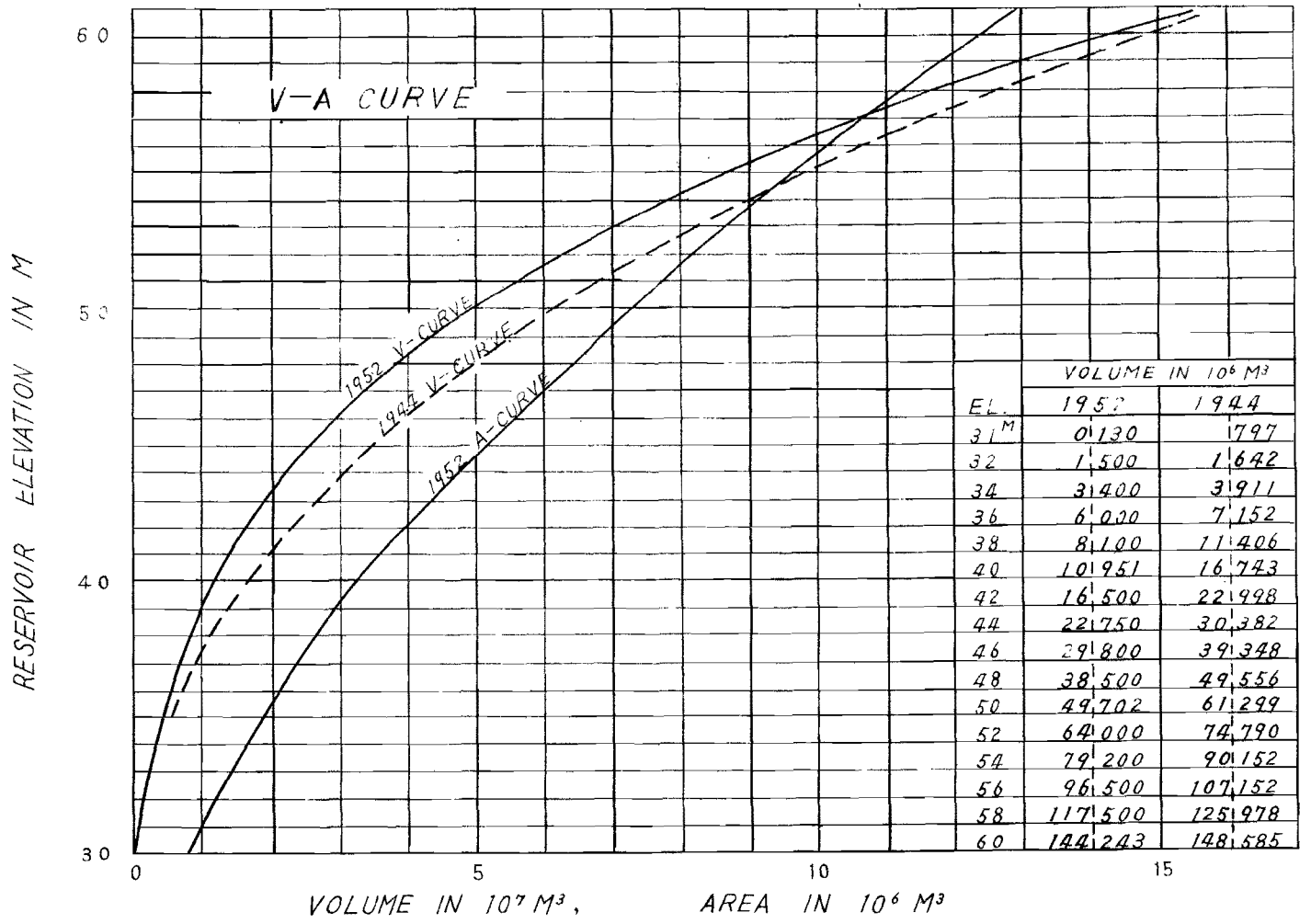

IRRIGATED AREA MAP
HSIN-YING
KWEI
CHUNG
To Tung-Shan
Hsiao-chiaotui
Tachiaotui
CHI
Shan-tzu-chiao
N
SCALE 1:50,000
0
1
2 KM
LEGEND
-- IMPROVED IRRIGATED AREA
-- NEW DEVELOPED AREA
-- CHIA-NAN IRRIGATED AREA
-- THE RESERVOIR
Kuo-yi-hou
CAMI
MAIN
NORTH
The site
CHIA-NAN
D.A = 1.60 Km²
To Kao-Hsiung

Fig 194

CORAL LAKE

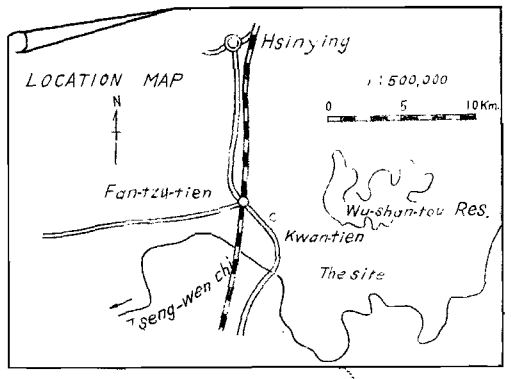


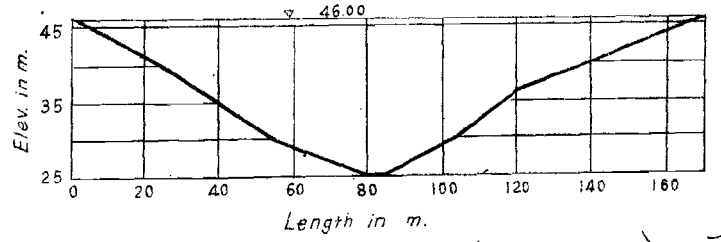
EL.	VOLUME IN 10^6 M^3	
	1952	1944
31 M	0 130	797
32	1 500	1 642
34	3 400	3 911
36	6 000	7 152
38	8 100	11 406
40	10 951	16 743
42	16 500	22 998
44	22 750	30 382
46	29 800	39 348
48	38 500	49 556
50	49 702	61 299
52	64 000	74 790
54	79 200	90 152
56	96 500	107 152
58	117 500	125 978
60	144 243	148 585

Fig 195

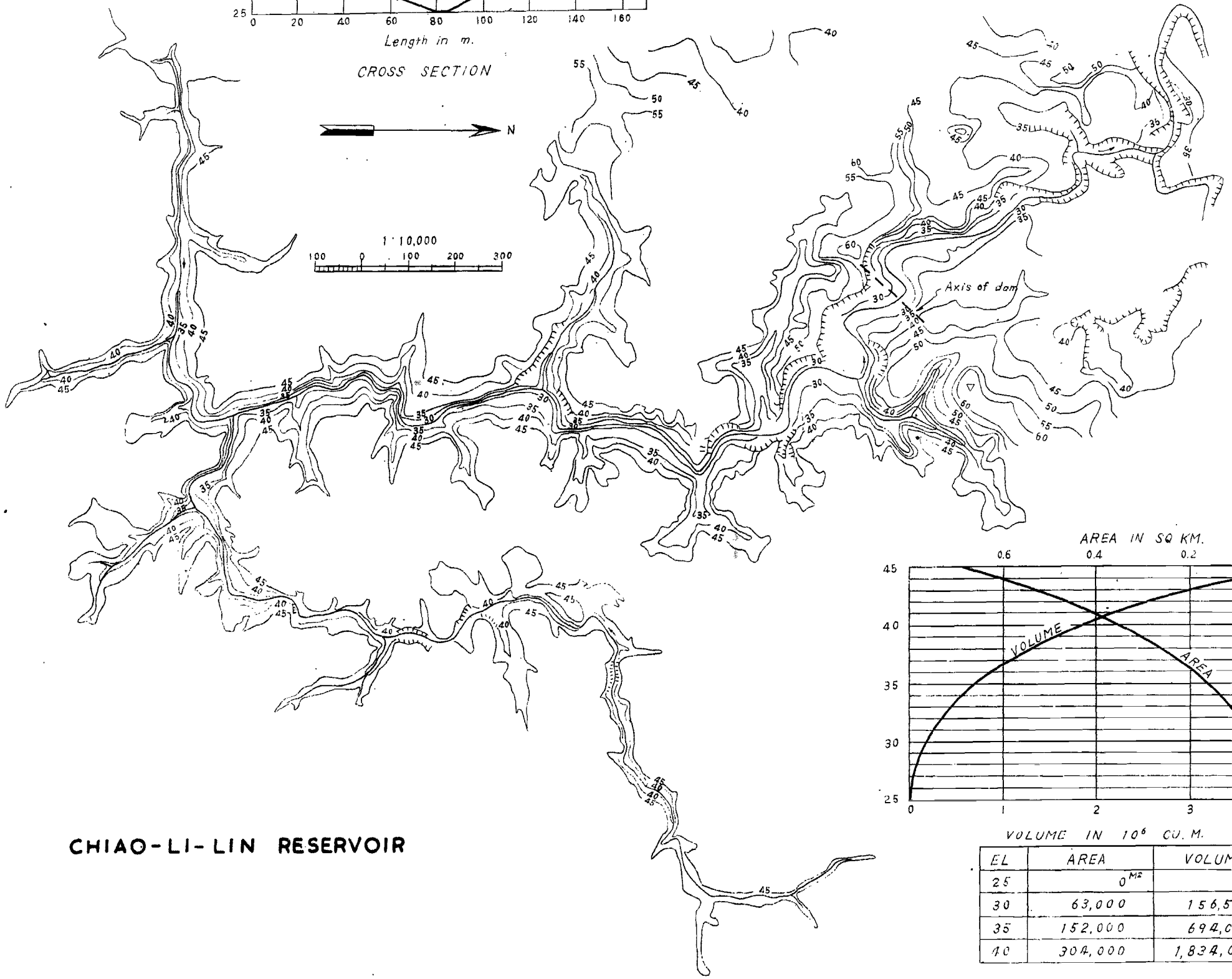
CHIAO-LI-LIN RESERVOIR

SCALE 1:25,000





CROSS SECTION

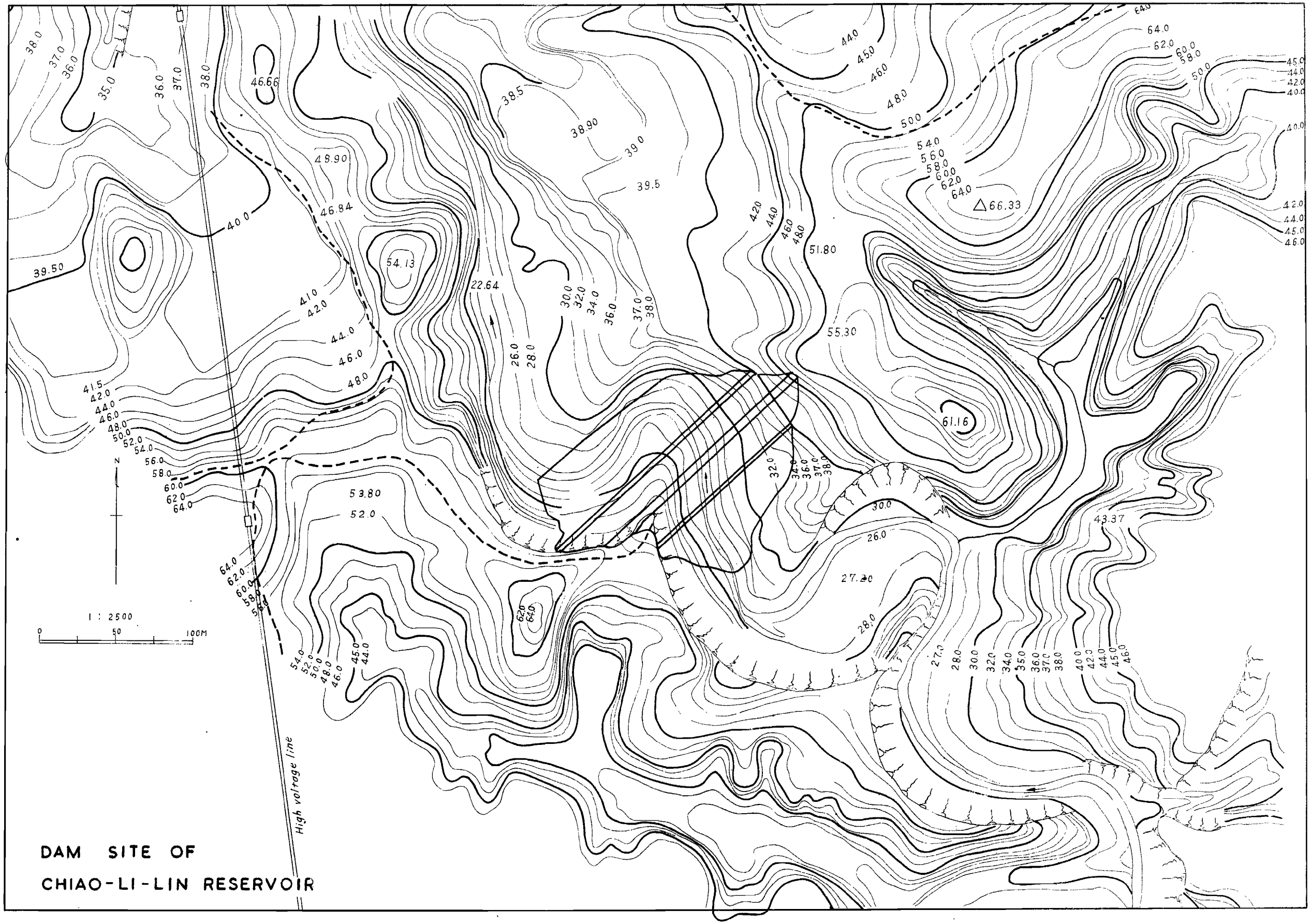


CHIAO-LI-LIN RESERVOIR

VOLUME IN 10^6 CU. M.

EL	AREA	VOLUME
25	0^{M2}	0^{M3}
30	63,000	156,500
35	152,000	694,000
40	304,000	1,834,000

Fig 198


N
1 : 2500
0
50
100M
High voltage line
DAM SITE OF
CHIAO-LI-LIN RESERVOIR

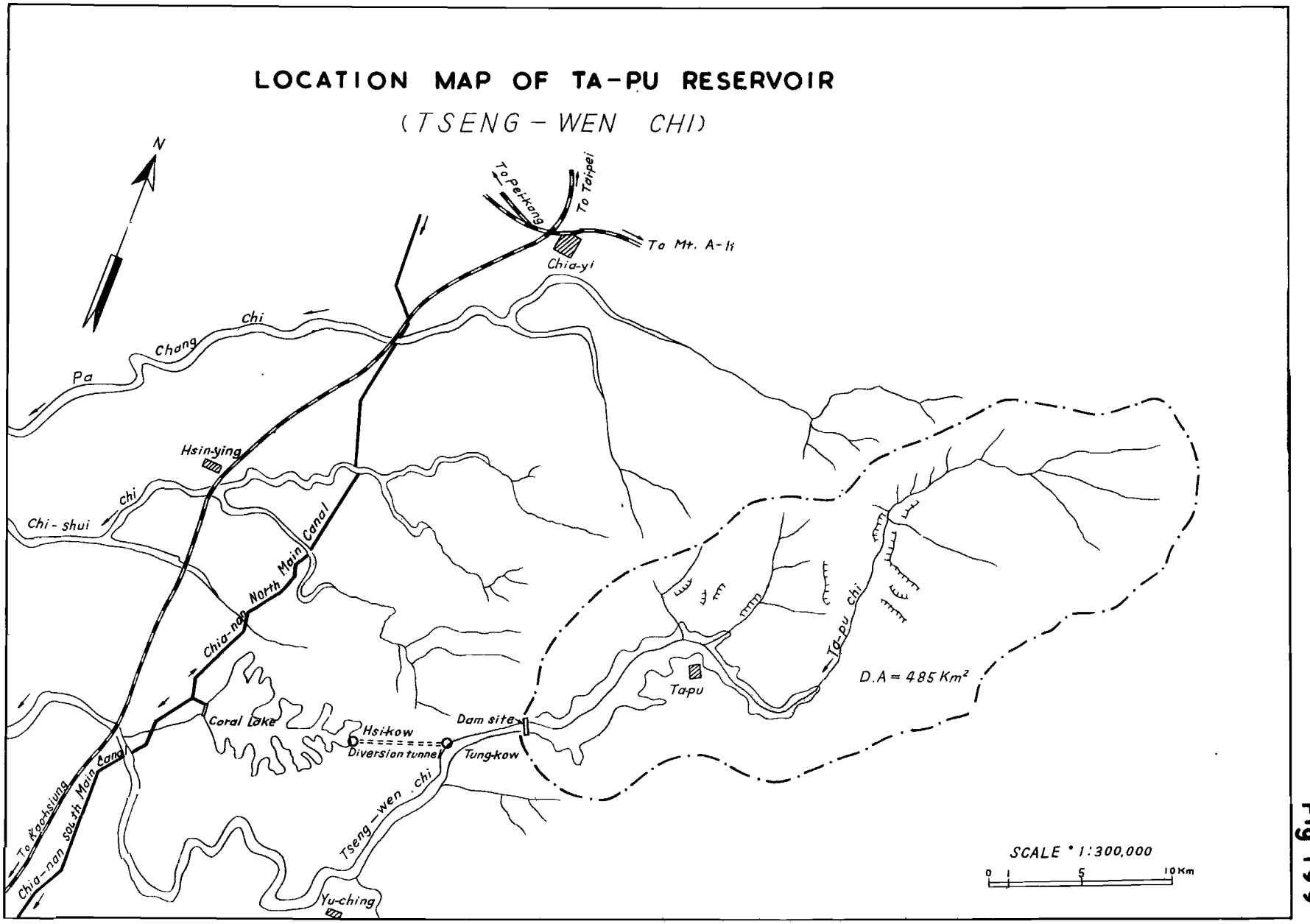
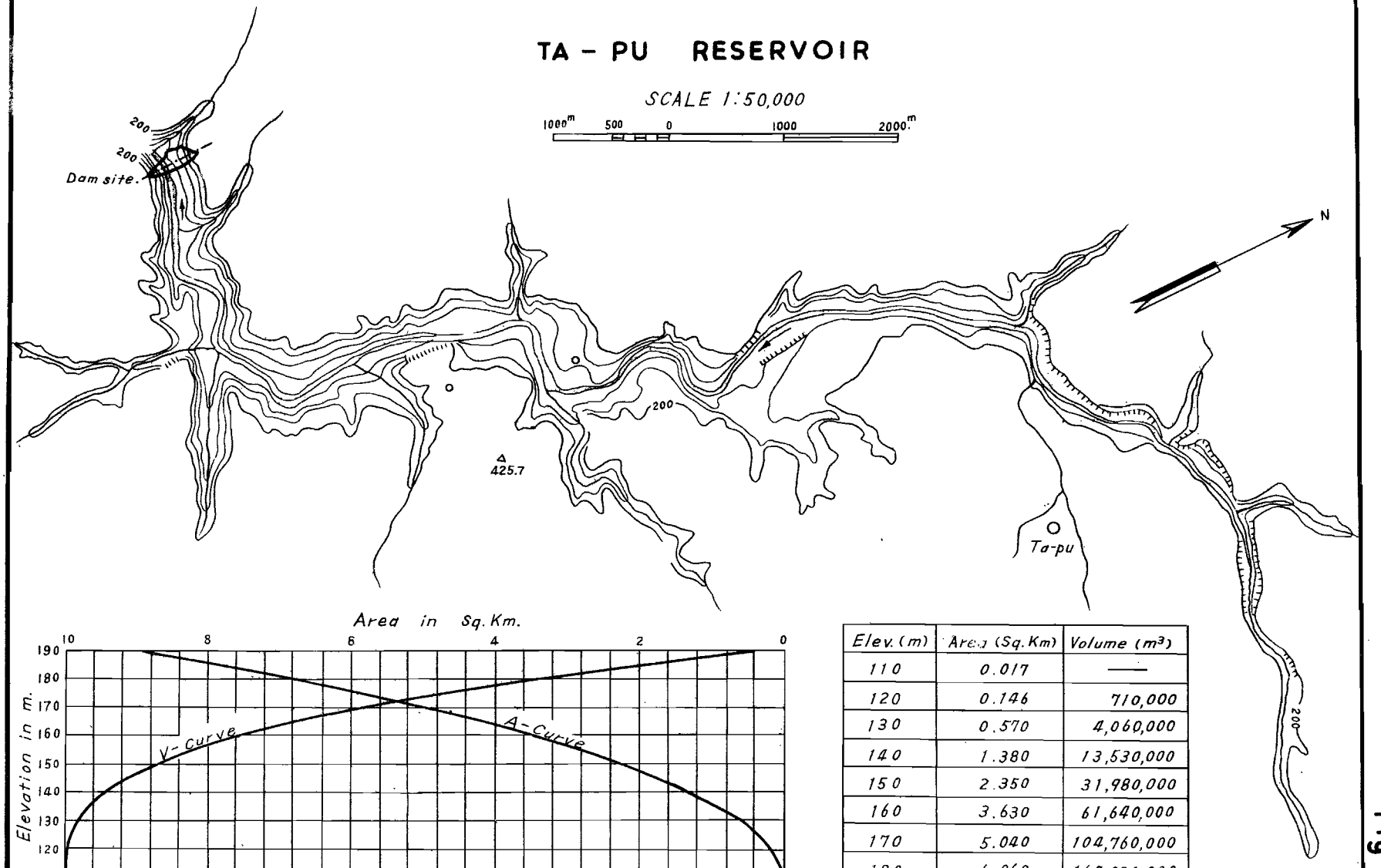

LOCATION MAP OF TA-PU RESERVOIR
(TSENG-WEN CHI)
N
To Pei-kang
To Taipei
To Mt. A-li
Chia-yi
Chang chi
Pa
Hsin-ying
Chi-shui chi
North Main Canal
Chia-nan
Ta-pu chi
D.A = 485 Km²
Ta-pu
Coral Lake
Hsi-kow
Diversion tunnel
Dam site
Tung-kow
To Kao-hsiung
Chia-nan south Main Canal
Tseng-wen chi
Yu-ching
SCALE : 1:300,000
0 1 5 10 Km

Fig 199

TA - PU RESERVOIR

SCALE 1:50,000

1000m 500 0 1000 2000m



Elev. (m)	Area (Sq. Km)	Volume (m^3)
110	0.017	——
120	0.146	710,000
130	0.570	4,060,000
140	1.380	13,530,000
150	2.350	31,980,000
160	3.630	61,640,000
170	5.040	104,760,000
180	6.860	164,020,000
190	9.030	243,250,000

Fig 200

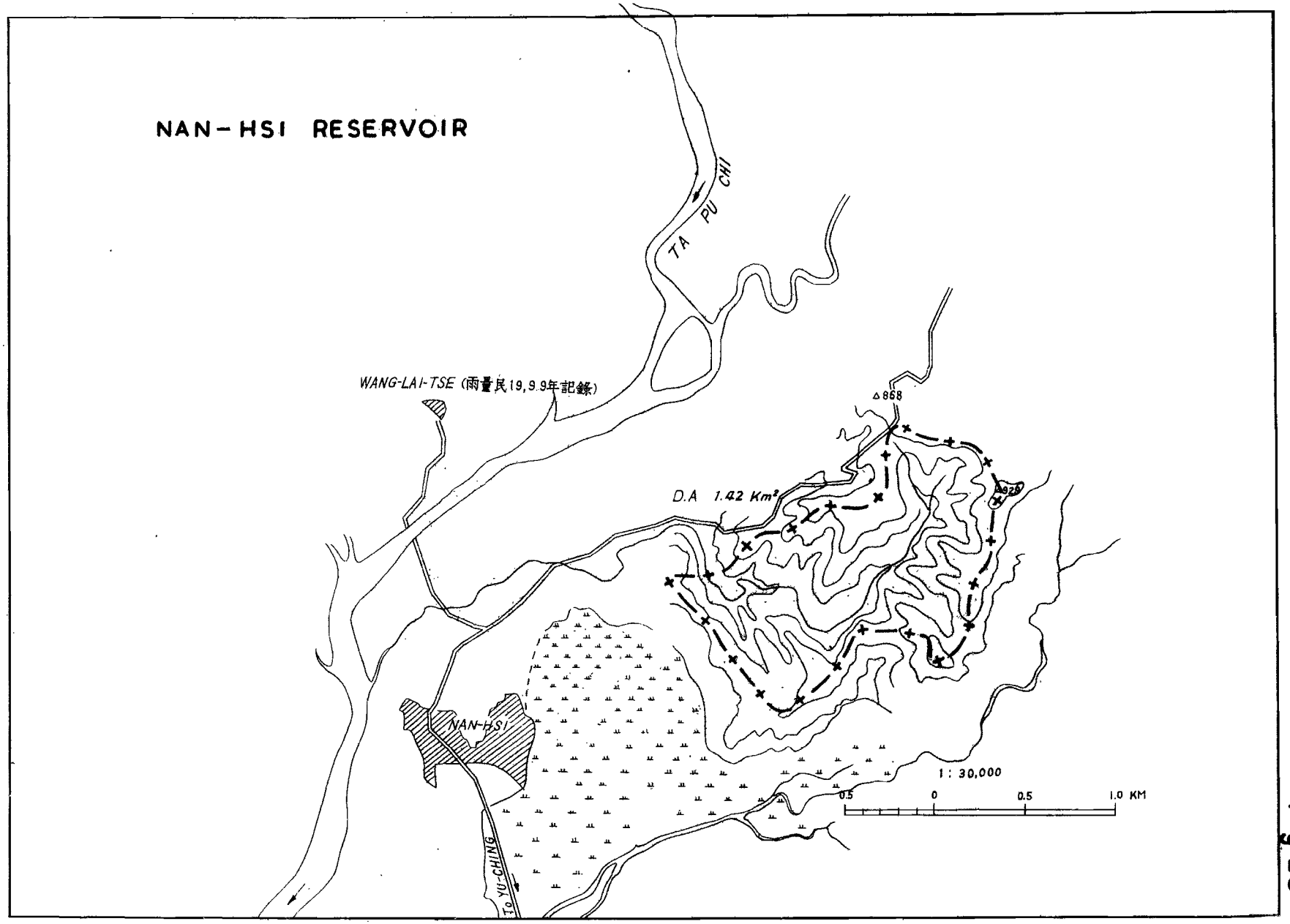
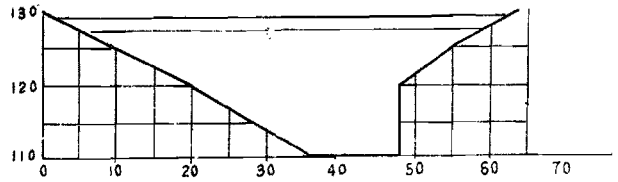

NAN-HSI RESERVOIR
TA PU CHI
WANG-LAI-TSE (雨量民19,9.9年記錄)
△868
△928
D.A 1.42 Km²
NAN-HSI
TO YU-CHING
1 : 30,000
0.5
0
0.5
1.0 KM

Fig. 201

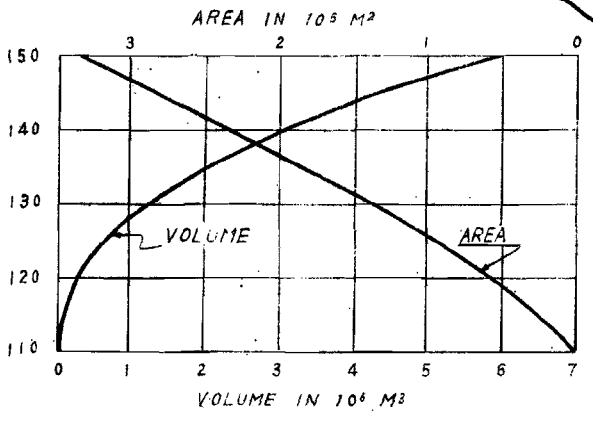
NAN – HSI RESERVOIR

CROSS SECTION



1 : 6,000

100 50 0 100 200 M



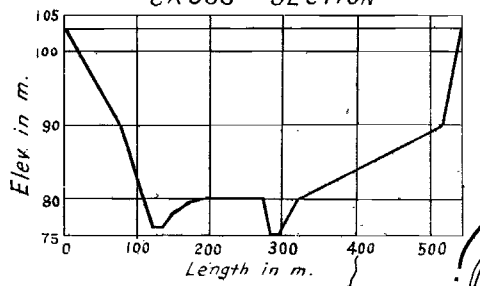
EL.	AREA	VOLUME
109	755 M²	188 M³
110	1,990	1,560
115	23,460	63,620
120	57,770	257,600
125	95,470	647,000
130	135,900	1,217,000
135	183,600	2,018,000
140	232,640	3,055,000

KWEI - TAN RESERVOIR.

SCALE 1:30,000

500m 0 1000m

CROSS SECTION



D.A = 17.96 KM²

ELE.	AREA	VOLUME
75 M	M²	M³
90	171,000	1,282,500
105	738,000	8,100,000
120	1,782,000	27,000,000

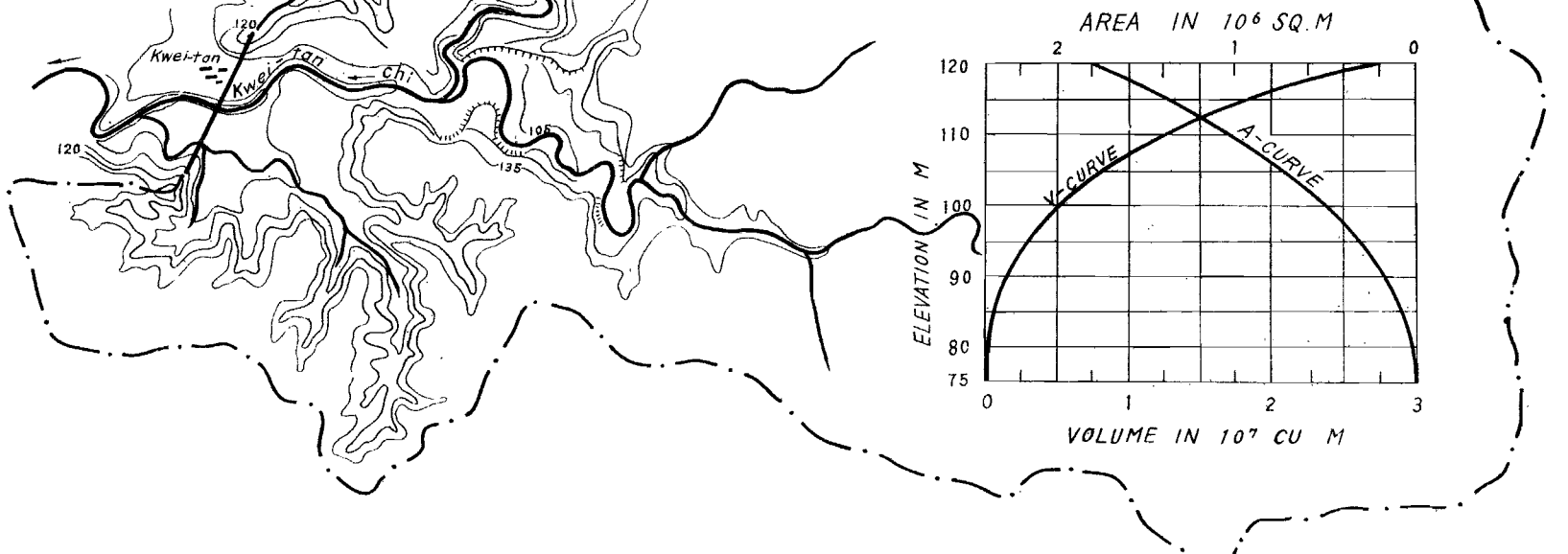


Fig 203

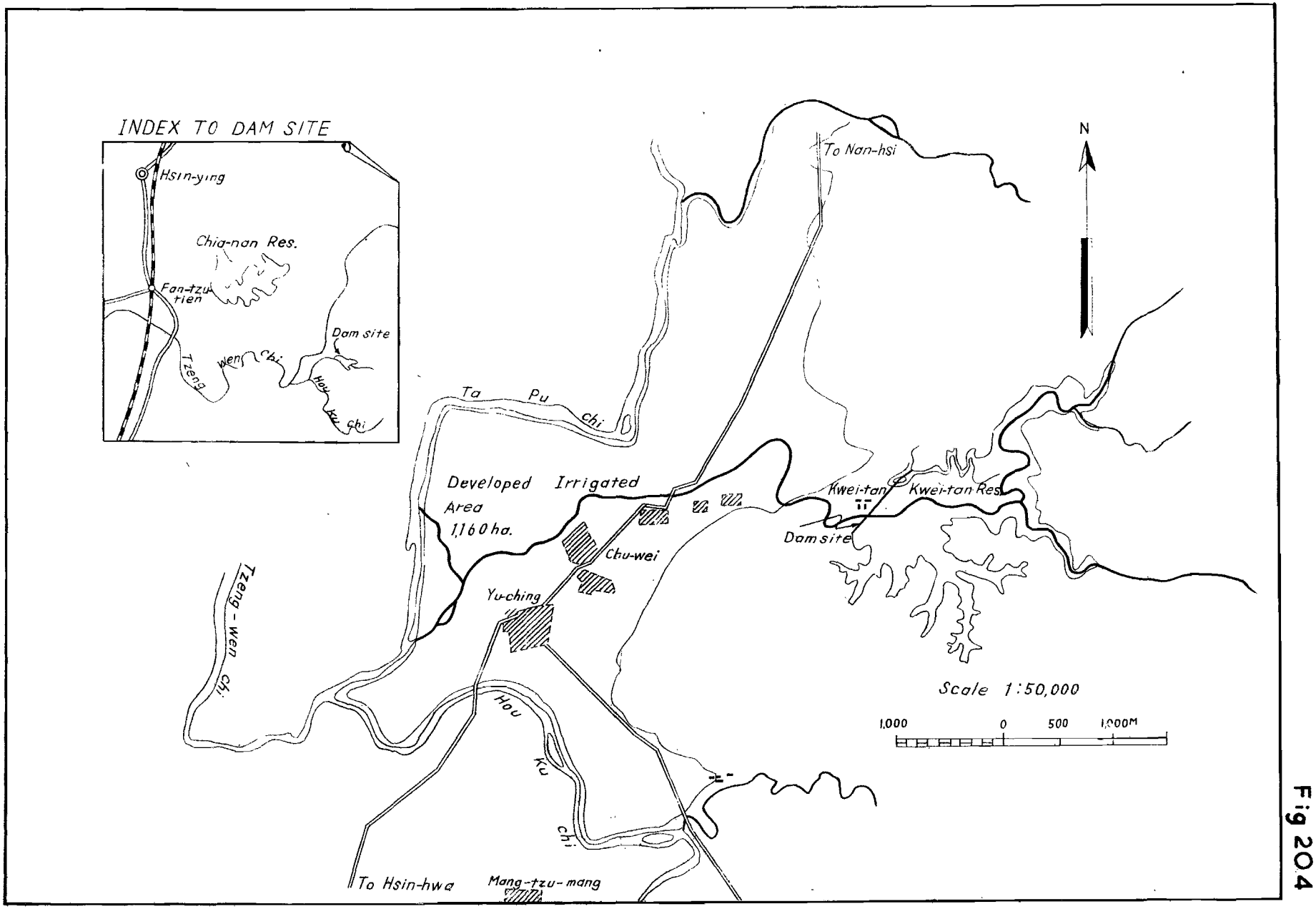

INDEX TO DAM SITE
Hsin-ying
Chia-nan Res.
Fan-tzu tien
Dam site
Tzeng Wen Chi
How ku chi
To Nan-hsi
N
Ta Pu chi
Developed Irrigated Area 1,160 ha.
Kwei-tan
Kwei-tan Res.
Dam site
Chu-wei
Yu-ching
Tzeng-wen chi
Hou Ku chi
Scale 1:50,000
1,000 0 500 1,000M
To Hsin-hwa
Mang-tzu-mang

Fig 20.4

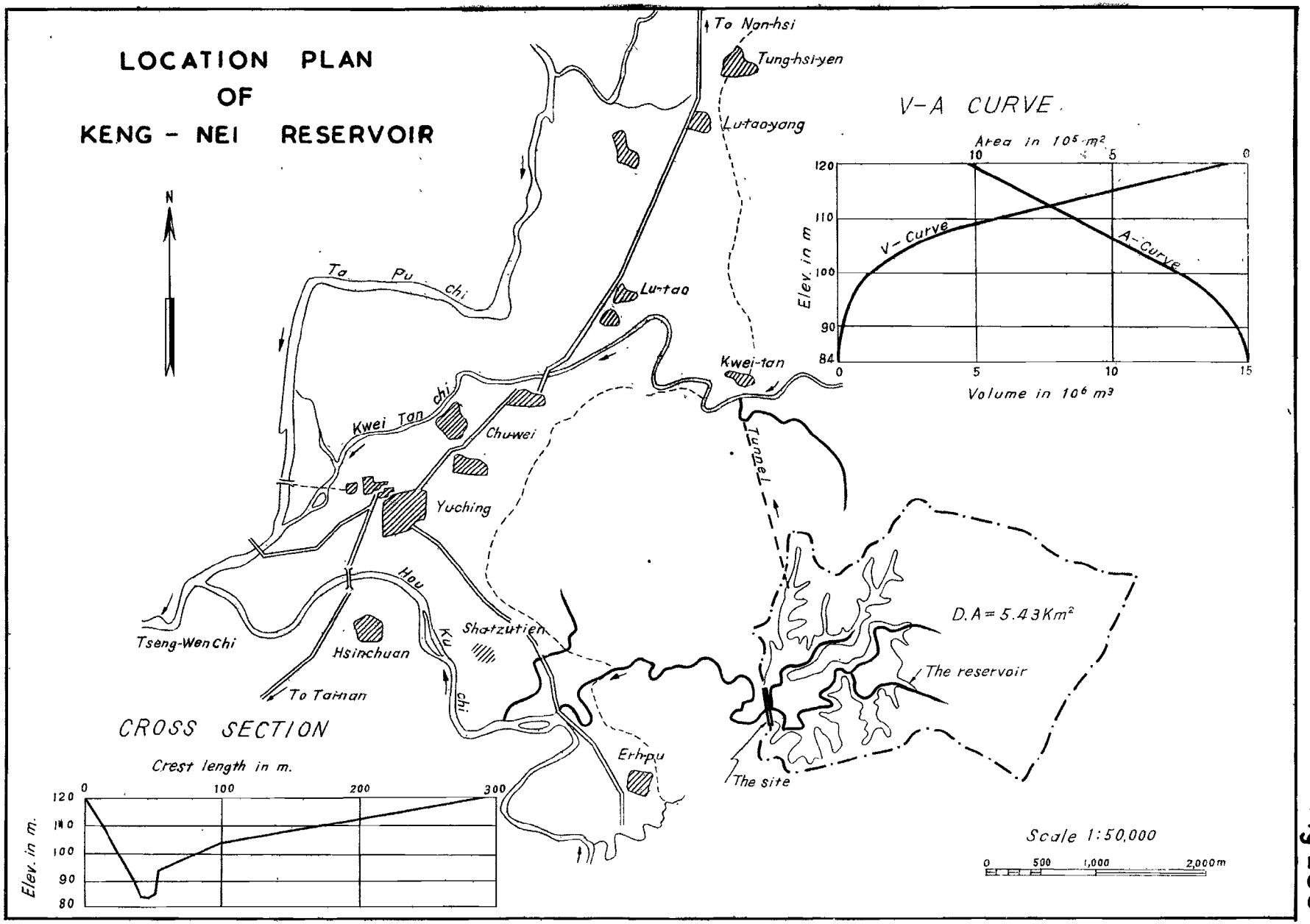
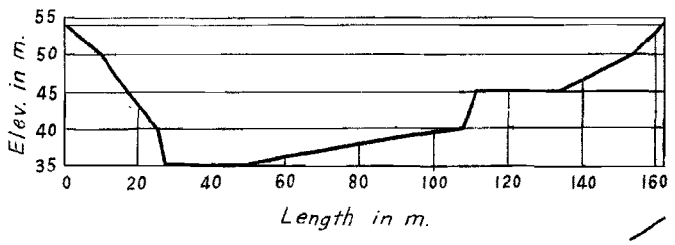

LOCATION PLAN
OF
KENG - NEI RESERVOIR
N
To Nan-hsi
Tung-hsi-yen
Lu-tao-yang
Ta Pu chi
Lu-tao
Kwei-tan
Kwei Tan chi
Chu-wei
Yu-ching
Tunnel
Hou Ku chi
Tseng-Wen Chi
Hsin-chuan
To Tai-nan
Sha-tzu-tien
Erh-pu
The site
The reservoir
D.A = 5.43 Km²
V-A CURVE
Area in 10⁵ m²
10
5
0
120
110
100
90
84
Elev. in m
V-Curve
A-Curve
0
5
10
15
Volume in 10⁶ m³
CROSS SECTION
Crest length in m.
0
100
200
300
120
110
100
90
80
Elev. in m.
Scale 1:50,000
0
500
1,000
2,000 m

Fig 205

LOCATION PLAN OF NAPALIN RESERVOIR

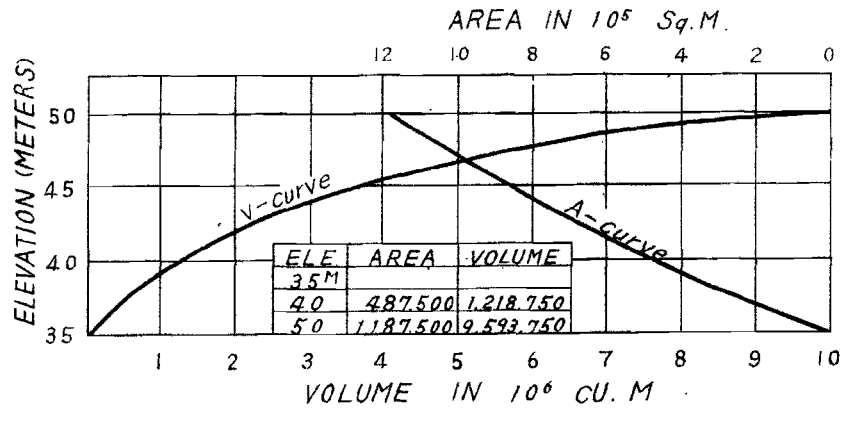
CROSS SECTION



SCALE 1/25,000

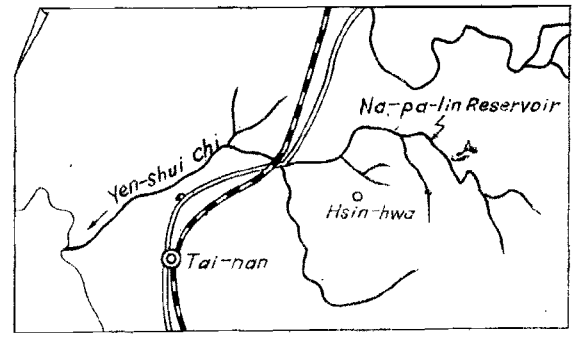
0 500 1000M

AREA IN 10^5 Sq.M.



ELE	AREA	VOLUME
35 M		
40	487,500	1,218,750
50	1,187,500	9,593,750

INDEX TO DAM SITE



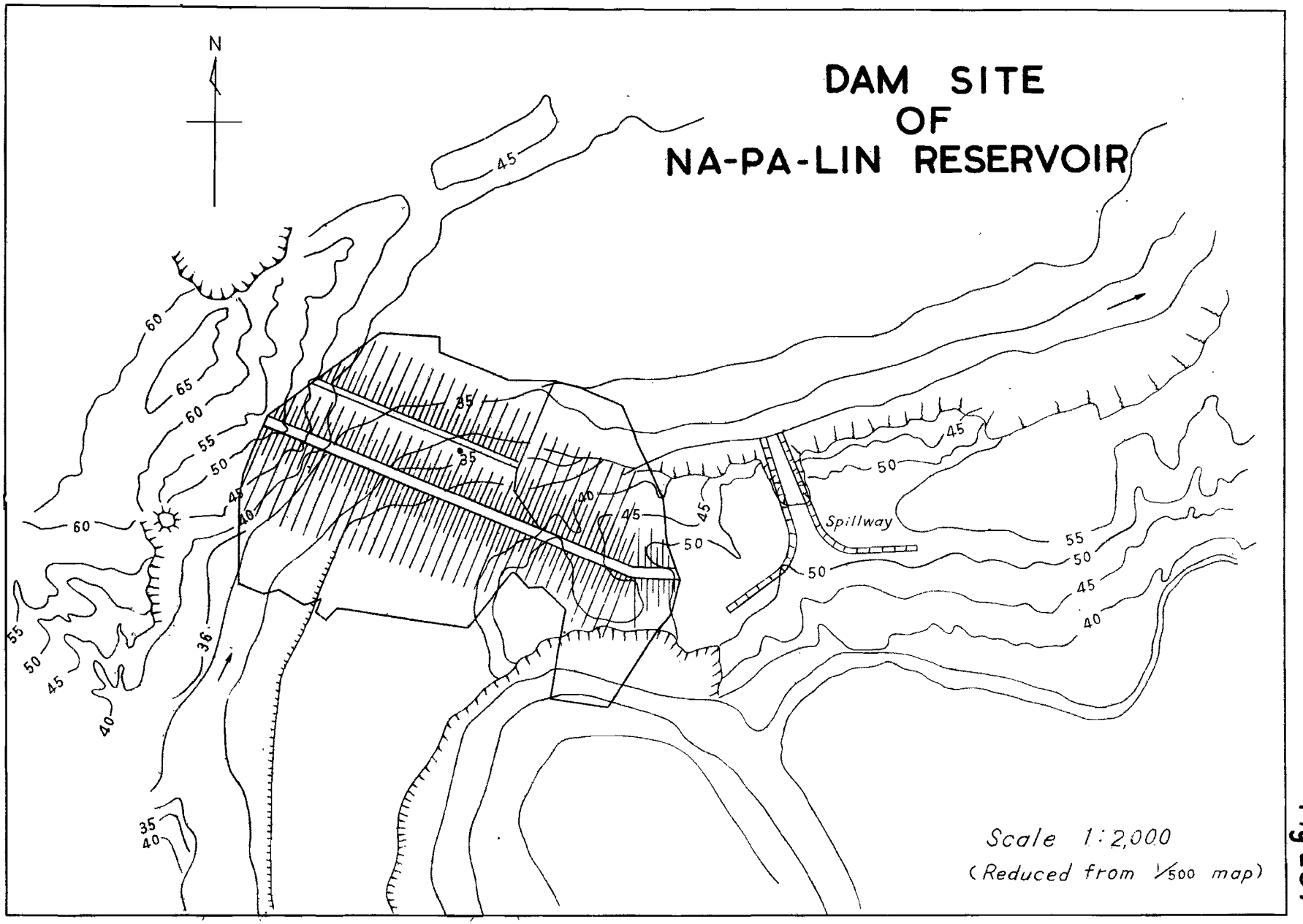
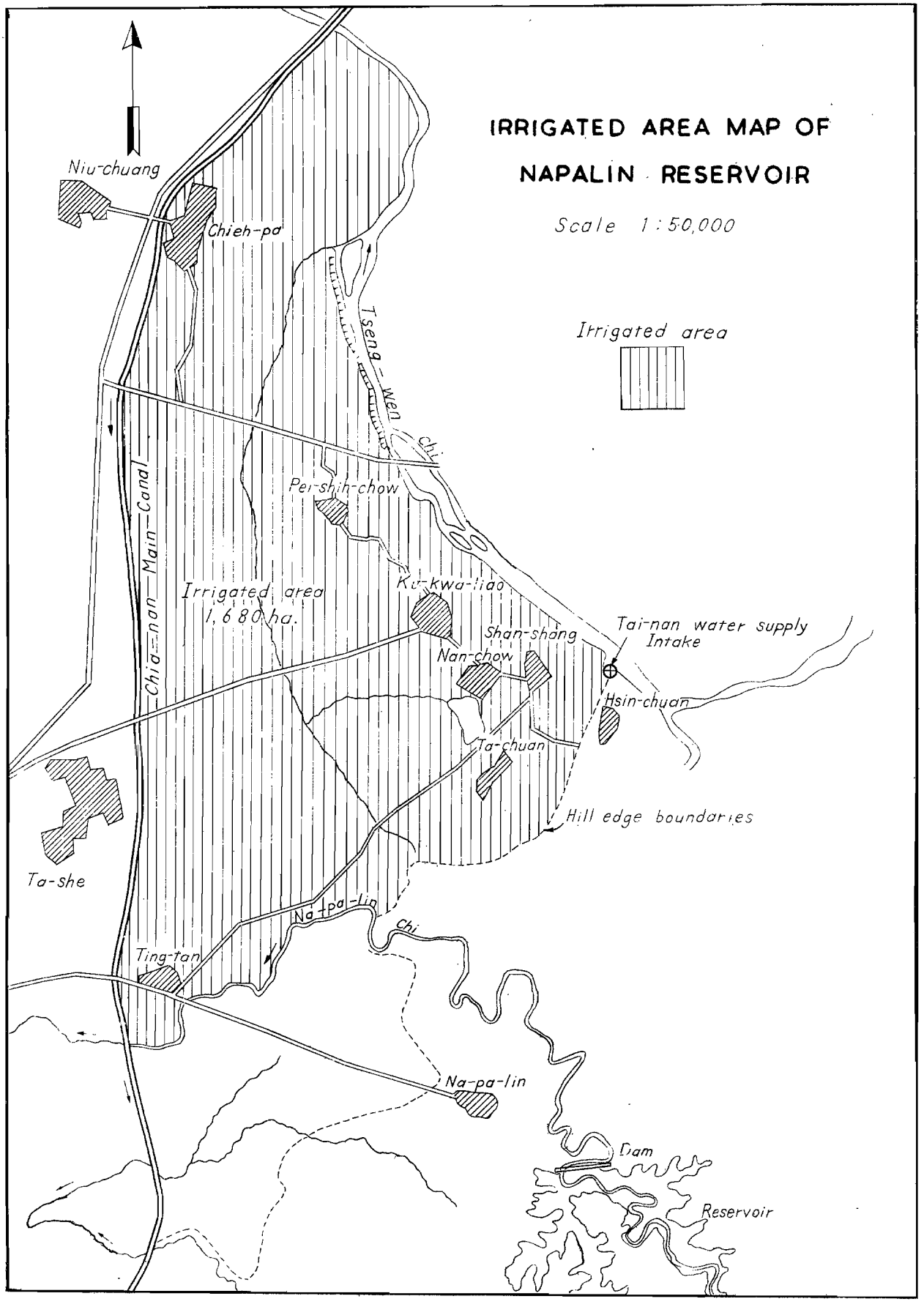

N
DAM SITE
OF
NA-PA-LIN RESERVOIR
Spillway
Scale 1:2,000
(Reduced from 1/500 map)

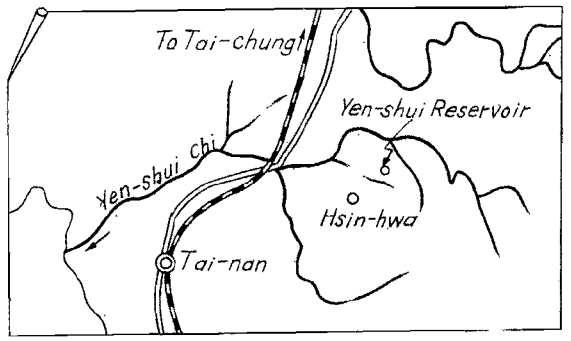
Fig 207

Fig 208


IRRIGATED AREA MAP OF
NAPALIN RESERVOIR
Scale 1:50,000
Irrigated area
Niu-chuang
Chieh-pa
Tseng-Wen Chi
Pei-shih-chow
Chia-nan Main Canal
Irrigated area
1,680 ha.
Ku-kwa-liao
Shan-shong
Nan-chow
Tai-nan water supply Intake
Hsin-chuan
Ta-chuan
Hill edge boundaries
Ta-she
Na-pa-lin Chi
Ting-tan
Na-pa-lin
Dam
Reservoir

LOCATION MAP OF YEN-SHUI RESERVOIR

INDEX TO DAM SITE



Yen-shui Chi

Improved
IRR. A. = 5.67 Km²

Wu Ming Chi

Yen-shui Reservoir

Hsin-hwa

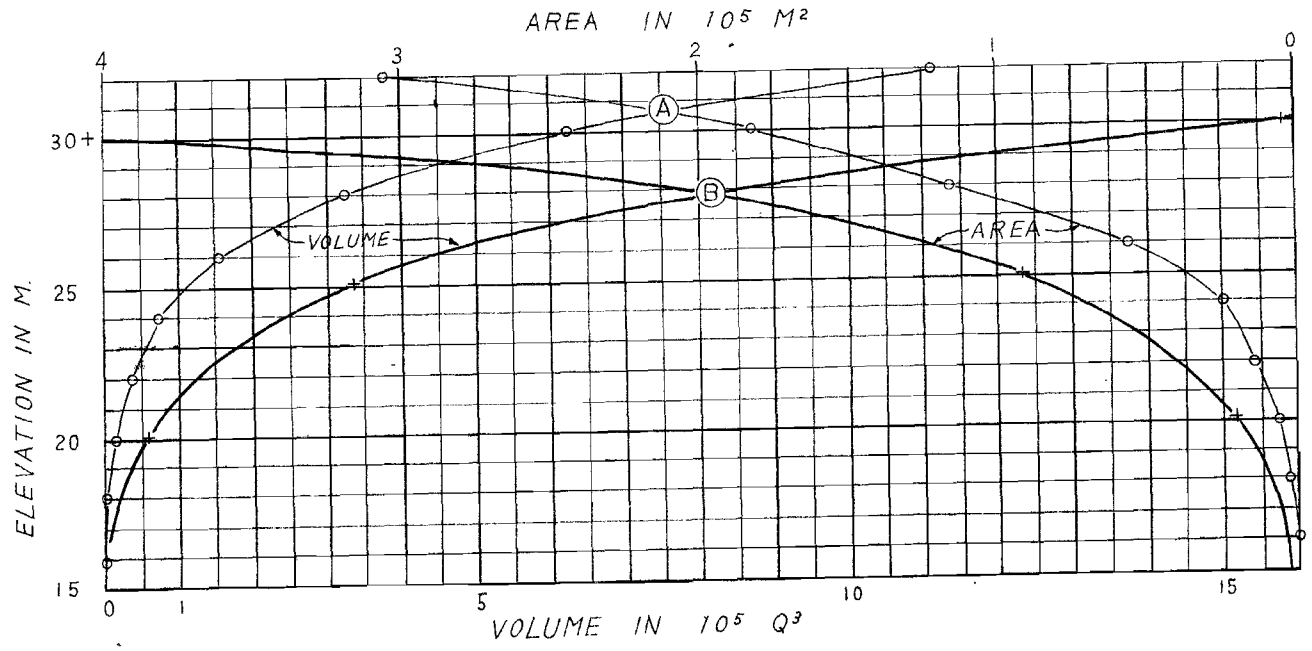
Hu Tou Chi

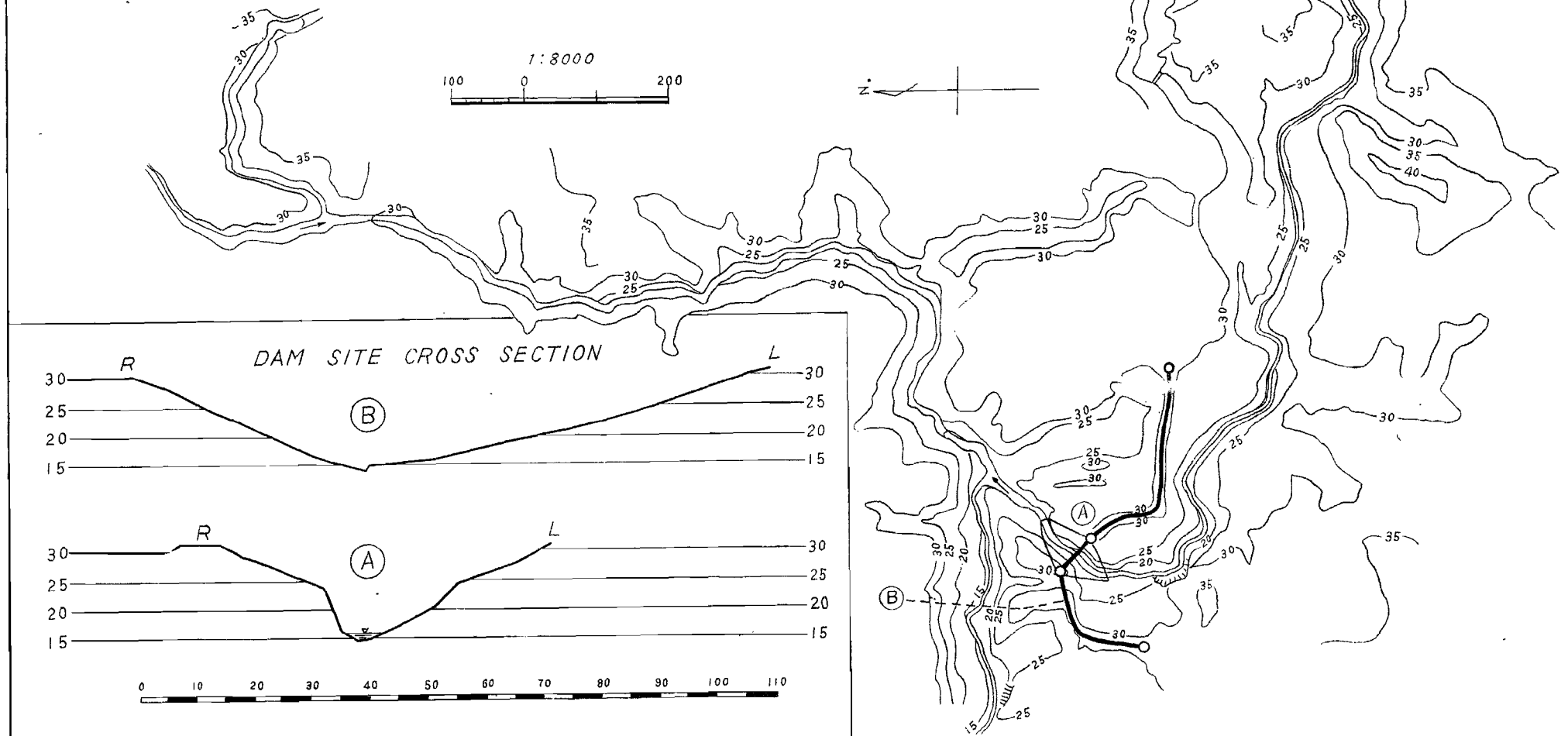
Hu-tou-pi

1 : 25,000

1 0 1 0 Km

YEN-SHUI RESERVOIR





ELEV	Ⓐ AREA in m²	Ⓐ VOLUME in m³	Ⓑ AREA in m²	Ⓑ VOLUME in m³
15	501	0	2560	
16	3151	3652		
18	7090	13893	20480	57600
20	13787	34770		
22	24485	73042		
24			91520	337600
25	56470	153997		
26	115871	326338		
28	182274	624483	405760	1580800
30	305855	1112612		
32				

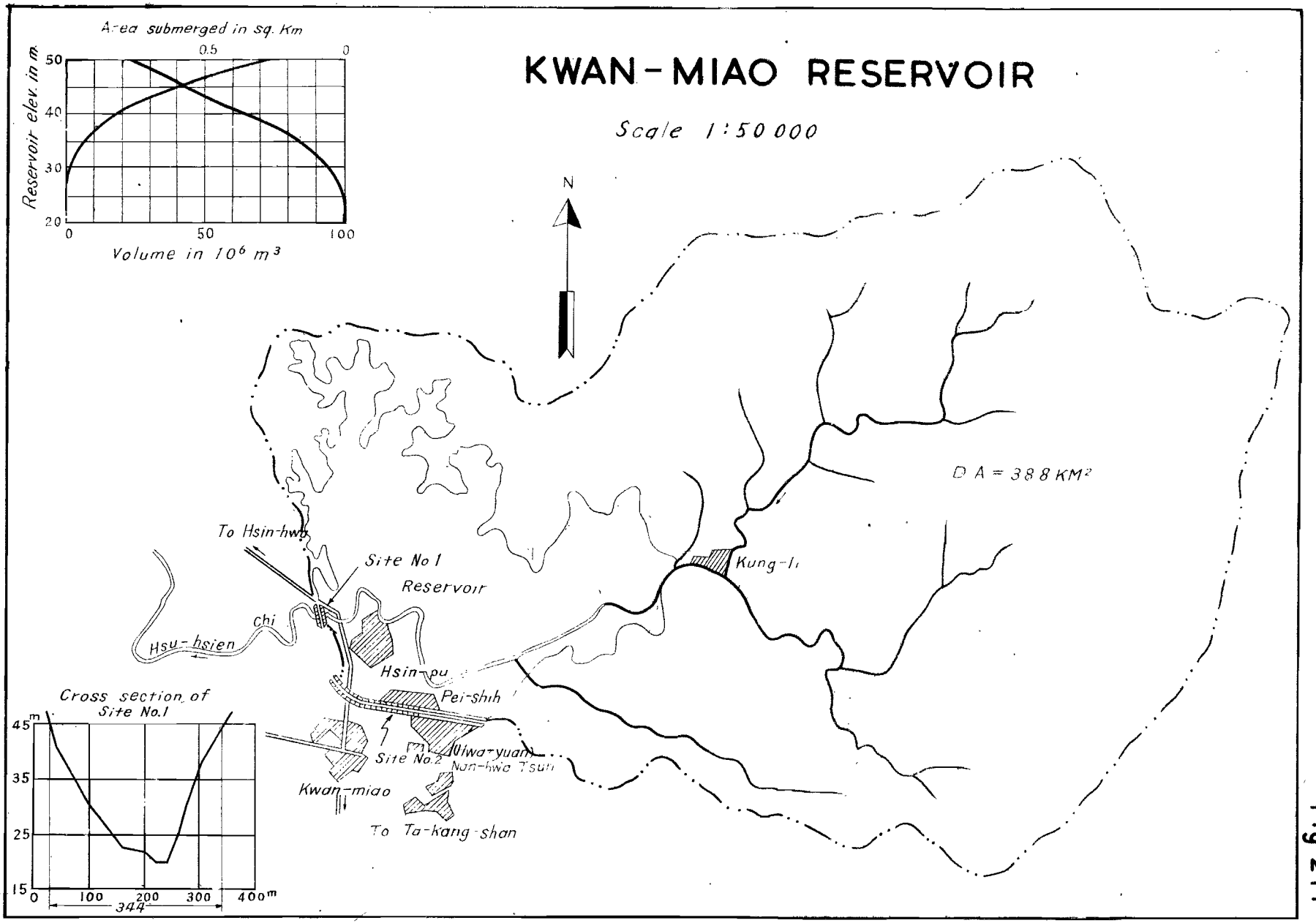

KWAN-MIAO RESERVOIR
Scale 1:50 000
N
D A = 388 KM²
To Hsin-hwa
Site No 1
Reservoir
Kung-li
Chi
Hsu-hsien
Hsin-pu
Pei-shih
Site No.2
Wan-yuan
Nan-hwa Tsuh
Kwan-miao
To Ta-kang-shan
Area submerged in sq. Km
0.5
0
Reservoir elev. in m
50
40
30
20
0
50
100
Volume in 10⁶ m³
Cross section of Site No.1
m
45
35
25
15
0
100
200
300
400m
344

Fig 211

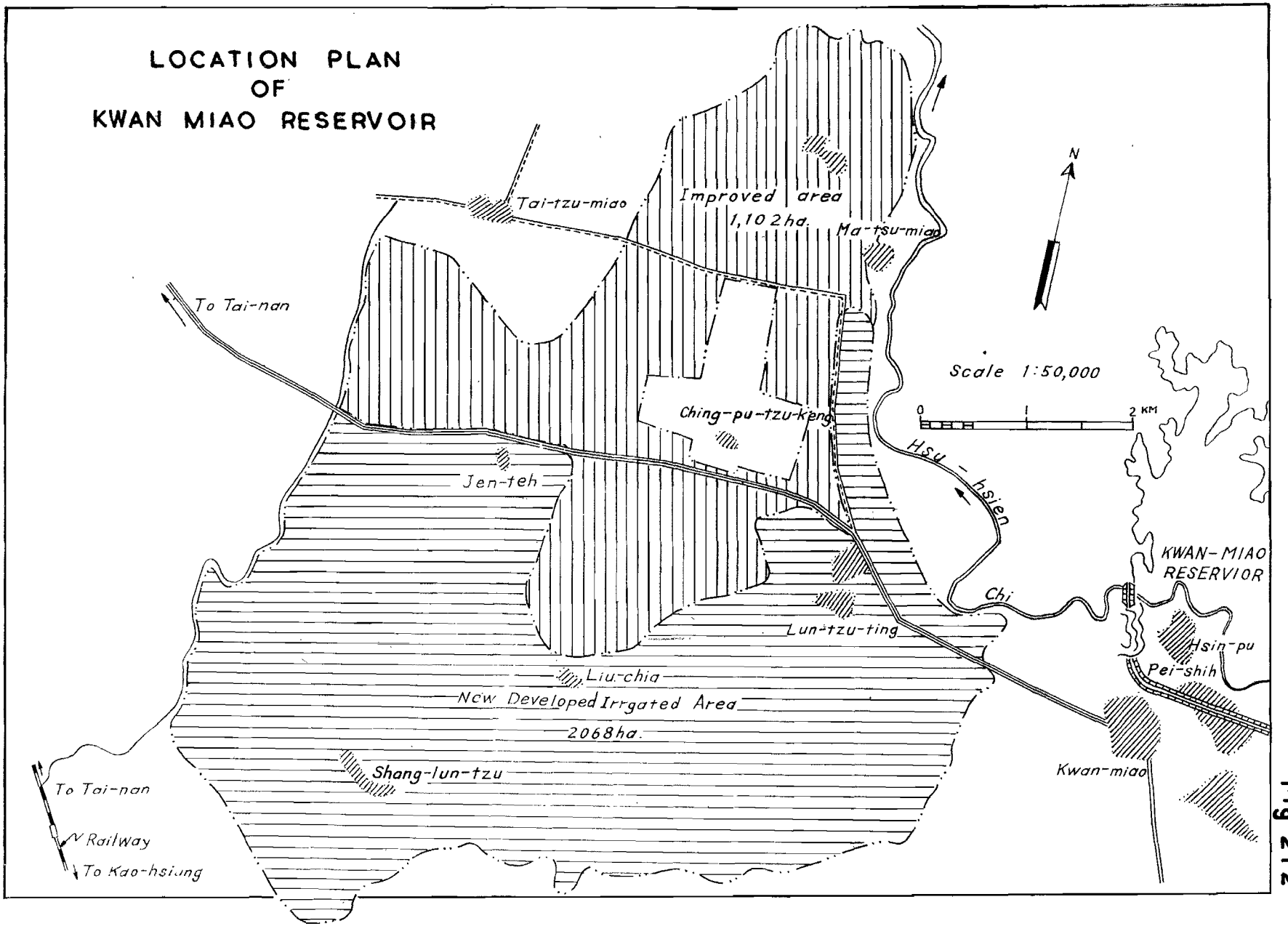

LOCATION PLAN
OF
KWAN MIAO RESERVOIR
Improved area
1,102 ha.
Tai-tzu-miao
Ma-tsu-miao
To Tai-nan
N
Scale 1:50,000
0
1
2 KM
Ching-pu-tzu-keng
Jen-teh
Hsu-hsien
KWAN-MIAO
RESERVIOR
Chi
Lun-tzu-ting
Hsin-pu
Pei-shih
Liu-chia
New Developed Irrgated Area
2068ha.
Shang-lun-tzu
Kwan-miao
To Tai-nan
Railway
To Kao-hsiung

Fig 212

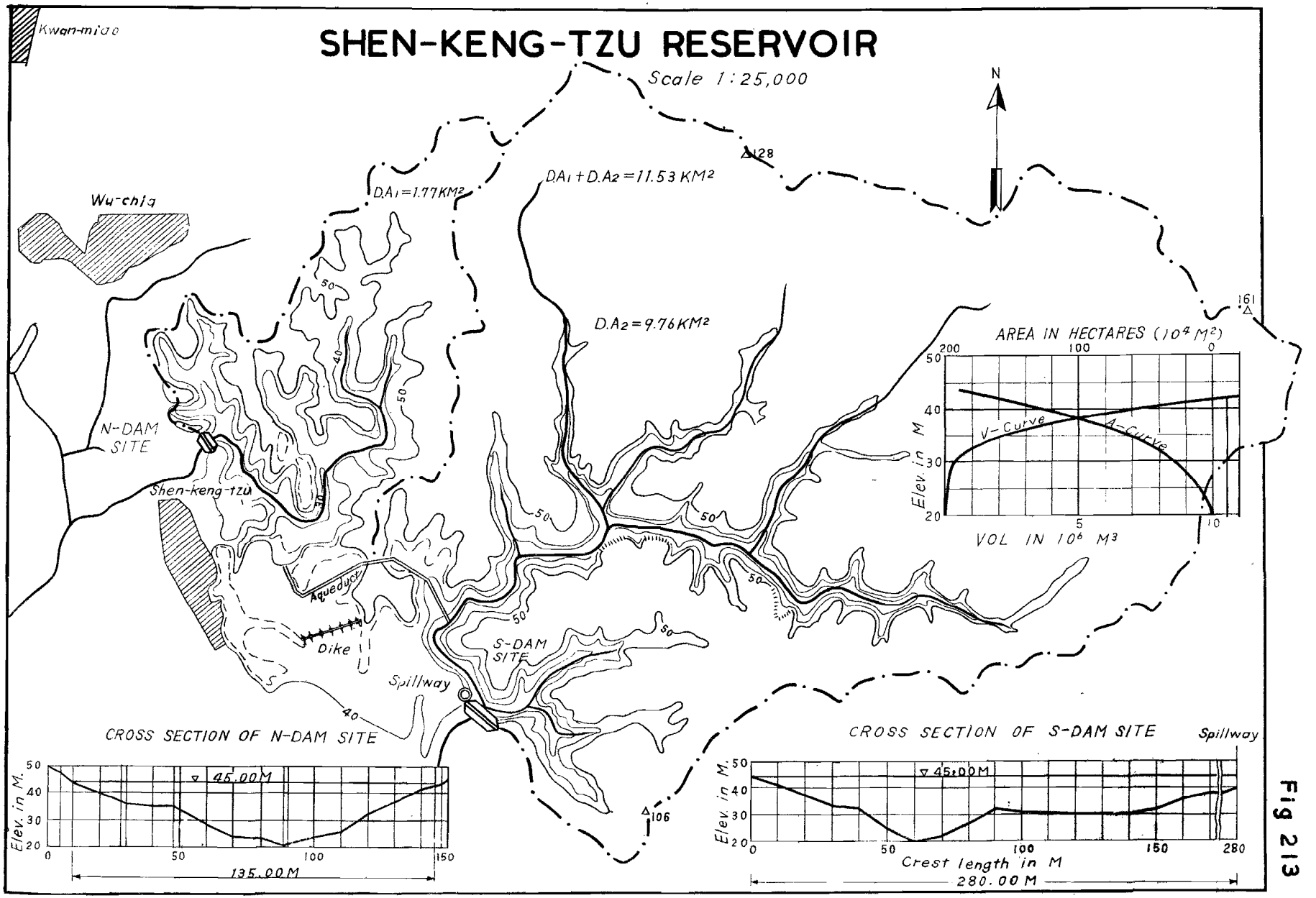

SHEN-KENG-TZU RESERVOIR
Scale 1:25,000
Kwan-miao
Wu-chia
N
128
161
106
D.A1=1.77KM2
D.A1+D.A2=11.53 KM2
D.A2=9.76KM2
N-DAM SITE
Shen-keng-tzu
Aqueduct
Dike
S-DAM SITE
Spillway
AREA IN HECTARES (10⁴ M²)
V-Curve
A-Curve
Elev. in M
VOL IN 10⁶ M³
CROSS SECTION OF N-DAM SITE
45.00M
135.00M
CROSS SECTION OF S-DAM SITE
Spillway
45.00M
Crest length in M
280.00 M

Fig 213

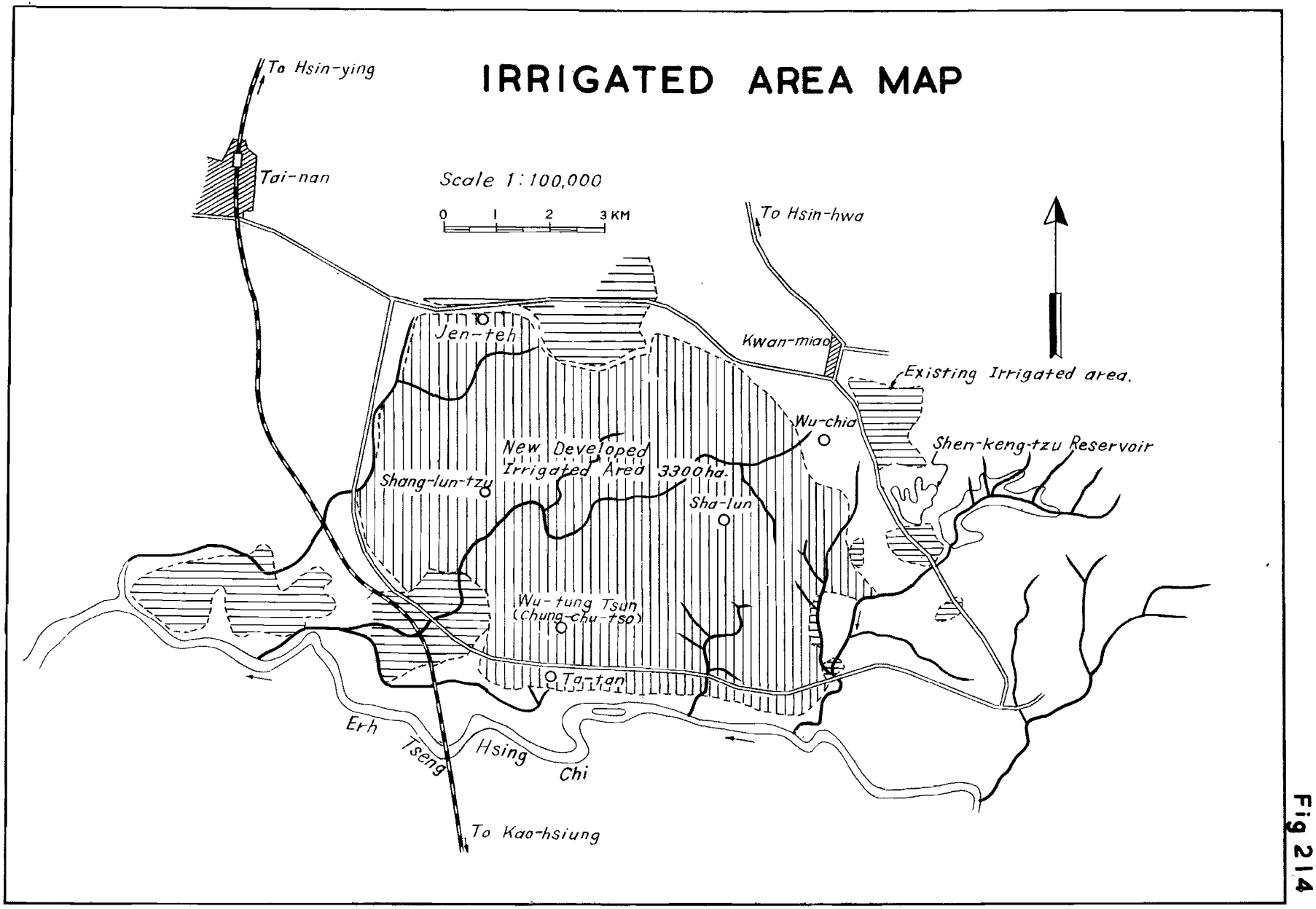
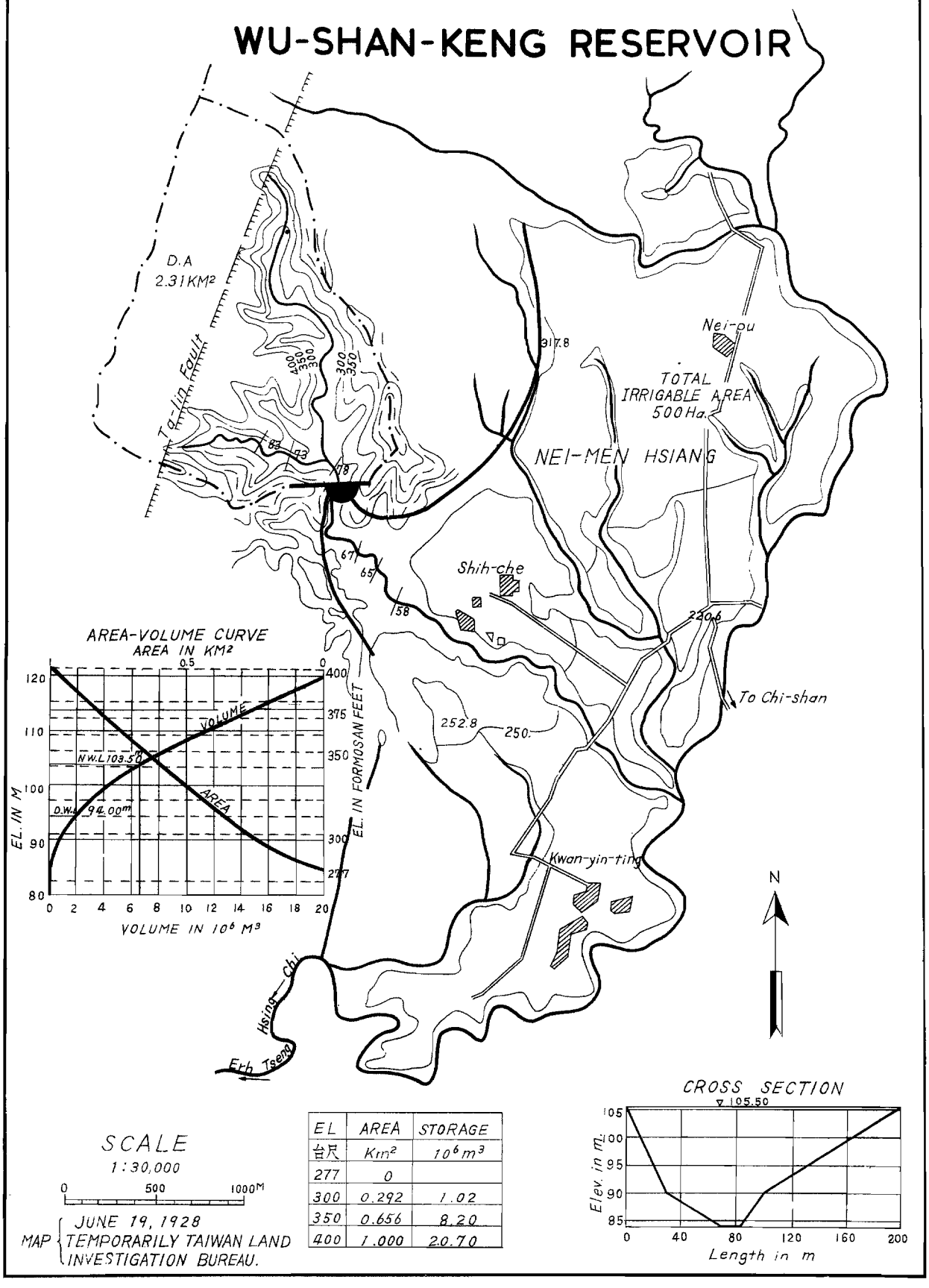

IRRIGATED AREA MAP
To Hsin-ying
Tai-nan
Scale 1:100,000
0 1 2 3 KM
To Hsin-hwa
Jen-teh
Kwan-miao
Existing Irrigated area.
Wu-chia
Shen-keng-tzu Reservoir
New Developed Irrigated Area 3300ha.
Shang-lun-tzu
Sha-lun
Wu-tung Tsun (Chung-chu-tso)
Ta-tan
Erh Tseng Hsing Chi
To Kao-hsiung

Fig 2.1.4

WU-SHAN-KENG RESERVOIR

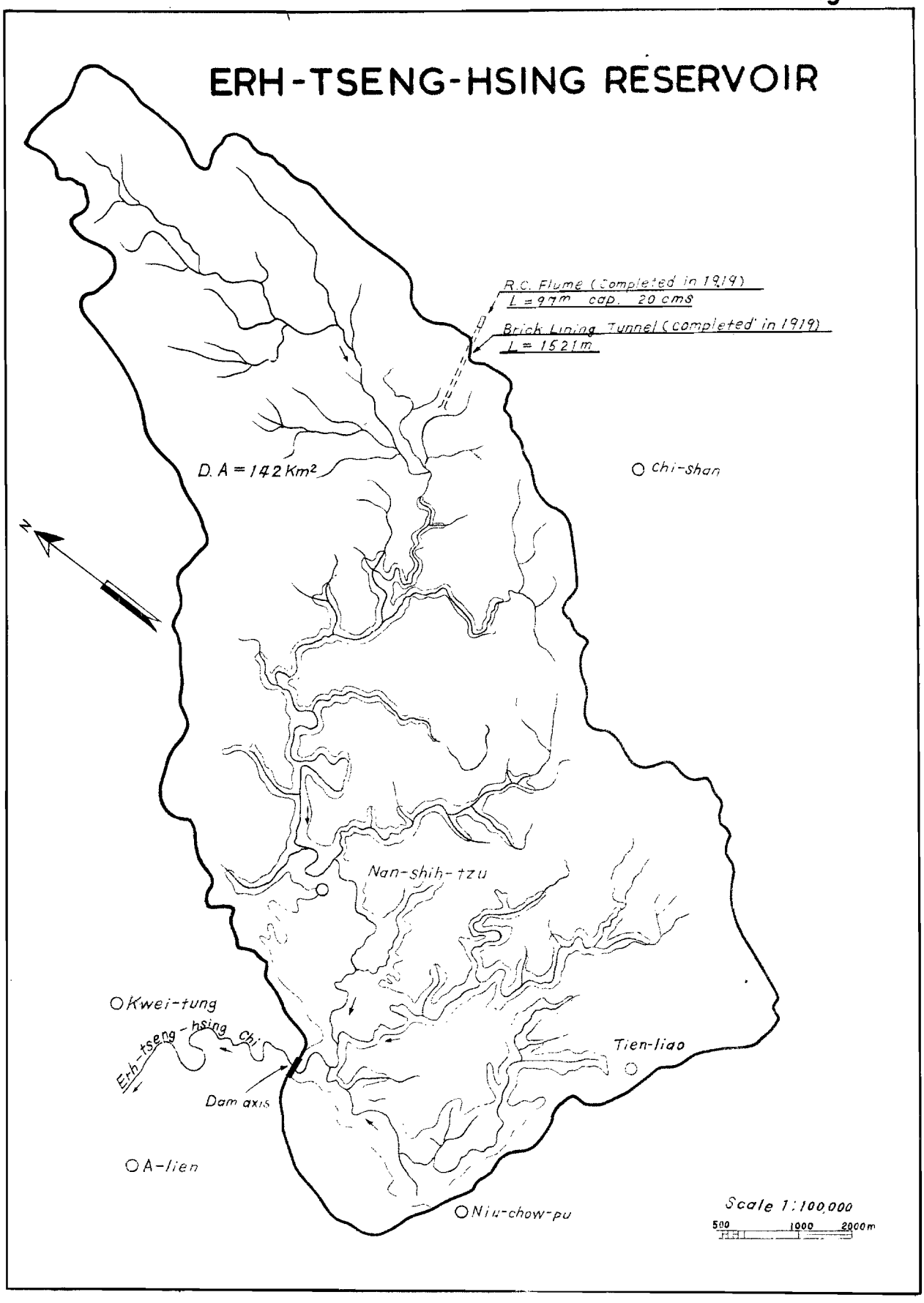


EL	AREA	STORAGE
台尺	Km²	10⁶m³
277	0	
300	0.292	1.02
350	0.656	8.20
400	1.000	20.70

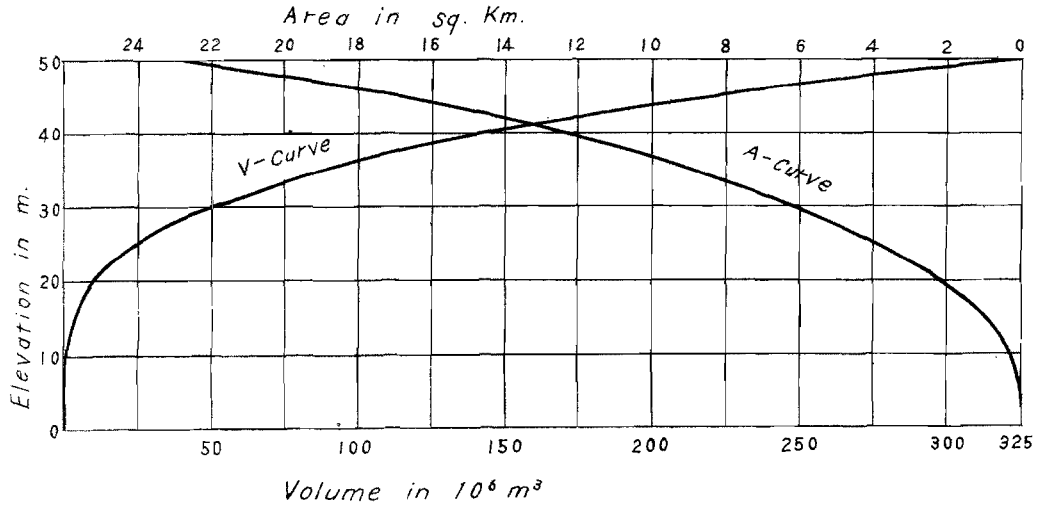
SCALE
1:30,000
0 500 1000M

MAP { JUNE 19, 1928
TEMPORARILY TAIWAN LAND
INVESTIGATION BUREAU.

Fig 216

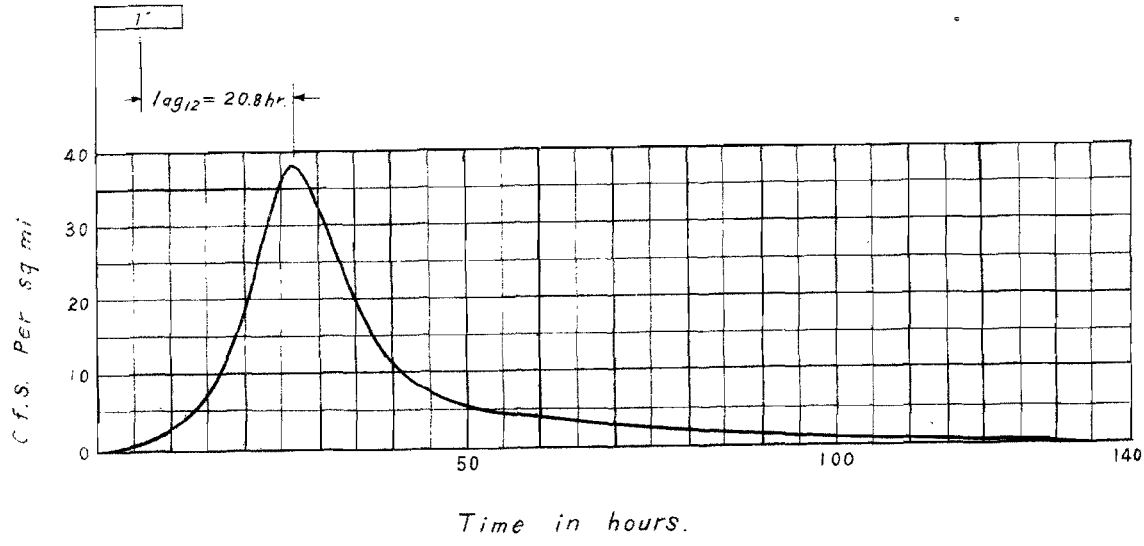

ERH-TSENG-HSING RESERVOIR
R.C. Flume (Completed in 1919)
L = 97m cap. 20 cms
Brick Lining Tunnel (completed in 1919)
L = 1521m
D. A = 142 Km²
Chi-Shan
N
Nan-shih-tzu
Kwei-tung
Erh-tseng-hsing Chi
Dam axis
Tien-liao
A-lien
Niu-chow-pu
Scale 1:100,000
500 1000 2000m

VOLUME-AREA CURVE



Elev. (m)	Area (m^2)	Volume (m^3)
50	22,600,000	325,000,000
40	12,300,000	140,000,000
30	6,200,000	50,000,000
20	2,000,000	10,000,000
420		

UNIT HYDROGRAPH



TOPOGRAPHIC MAP OF ERH-TSENG-HSING RESERVOIR

SCALE 1:2,500

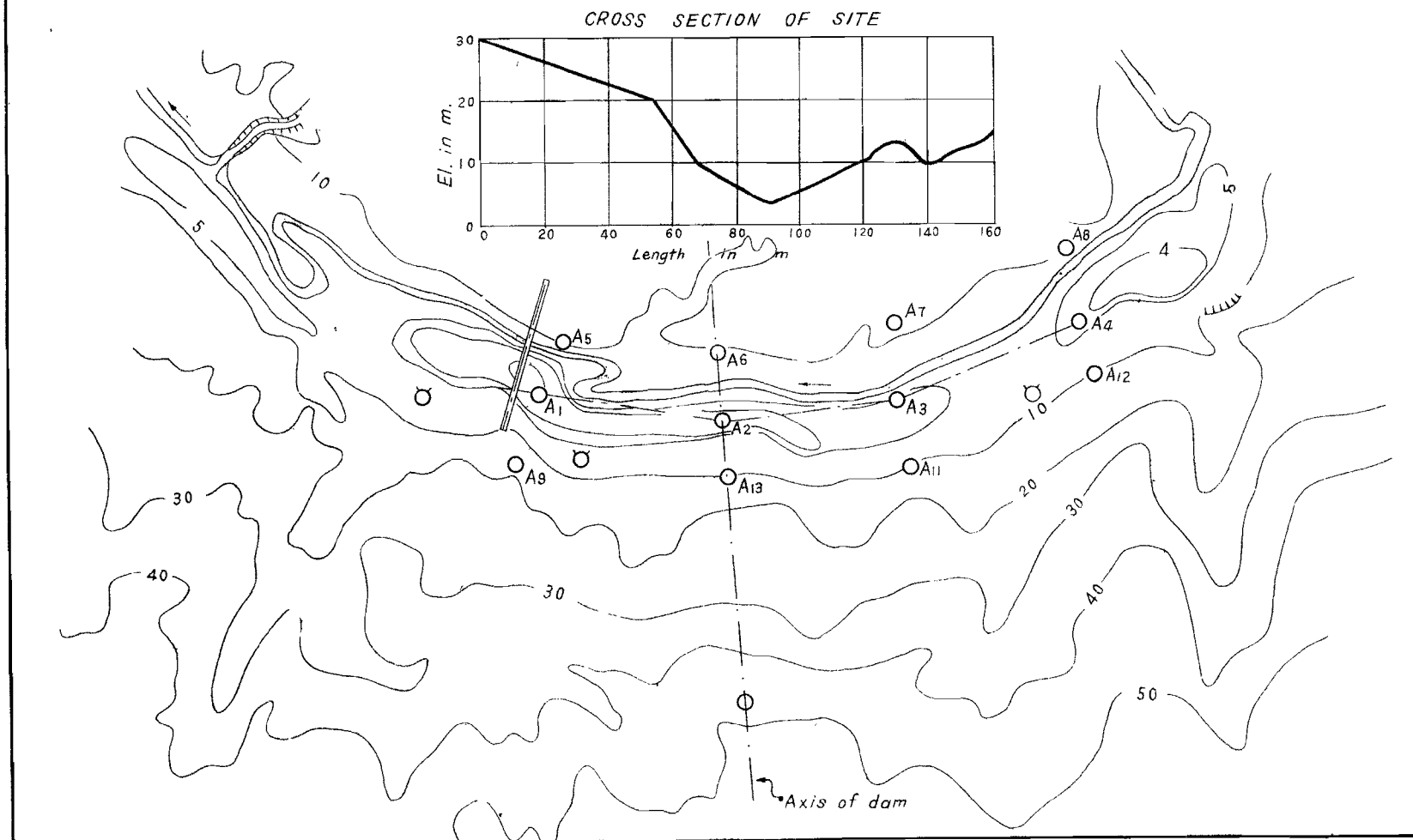


Fig 218

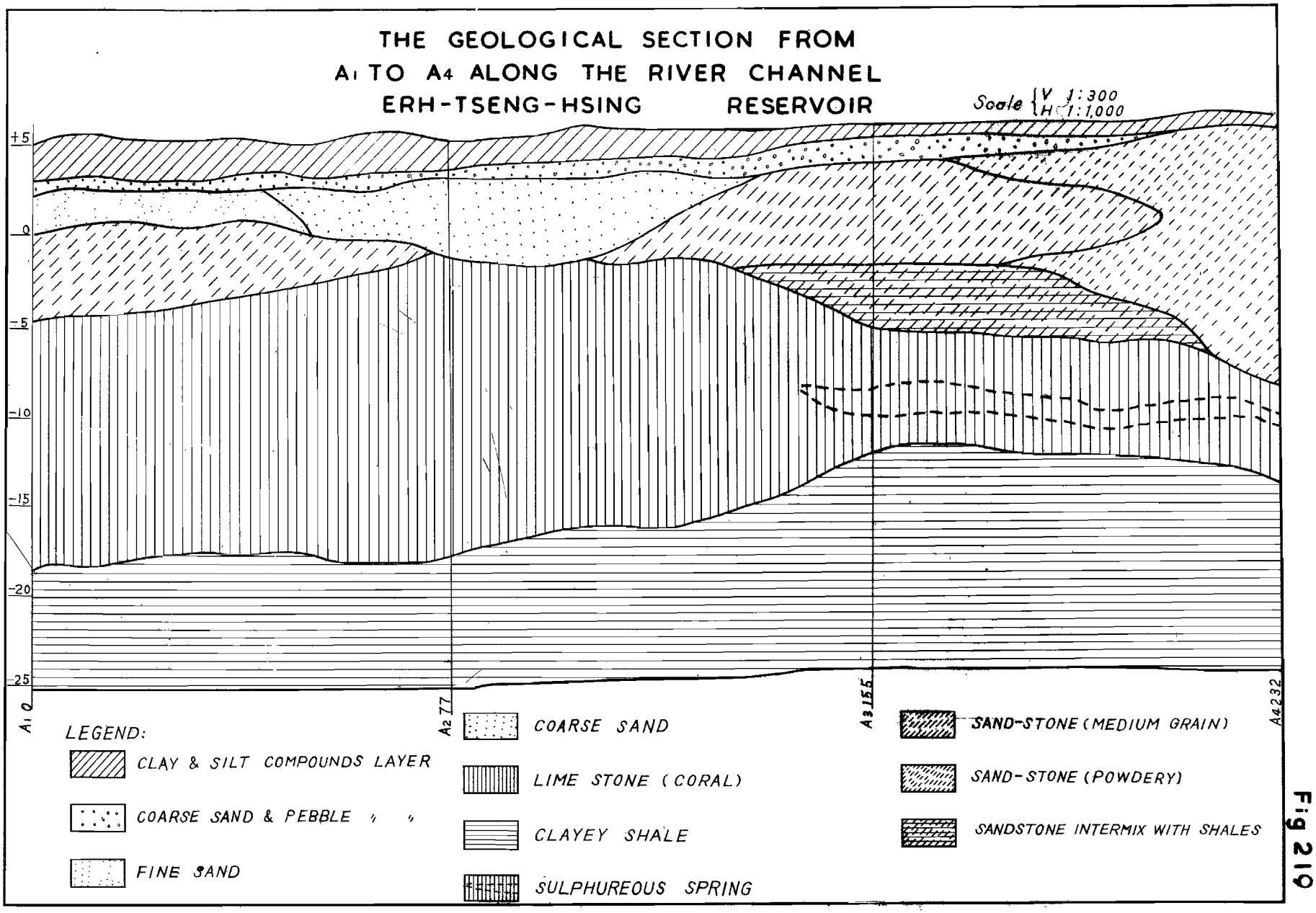

THE GEOLOGICAL SECTION FROM
A1 TO A4 ALONG THE RIVER CHANNEL
ERH-TSENG-HSING RESERVOIR
Scale V 1:300
H 1:1,000
+5
0
-5
-10
-15
-20
-25
A1 0
A2 77
A3 155
A4 232
LEGEND:
CLAY & SILT COMPOUNDS LAYER
COARSE SAND & PEBBLE
FINE SAND
COARSE SAND
LIME STONE (CORAL)
CLAYEY SHALE
SULPHUREOUS SPRING
SAND-STONE (MEDIUM GRAIN)
SAND-STONE (POWDERY)
SANDSTONE INTERMIX WITH SHALES

Fig 219

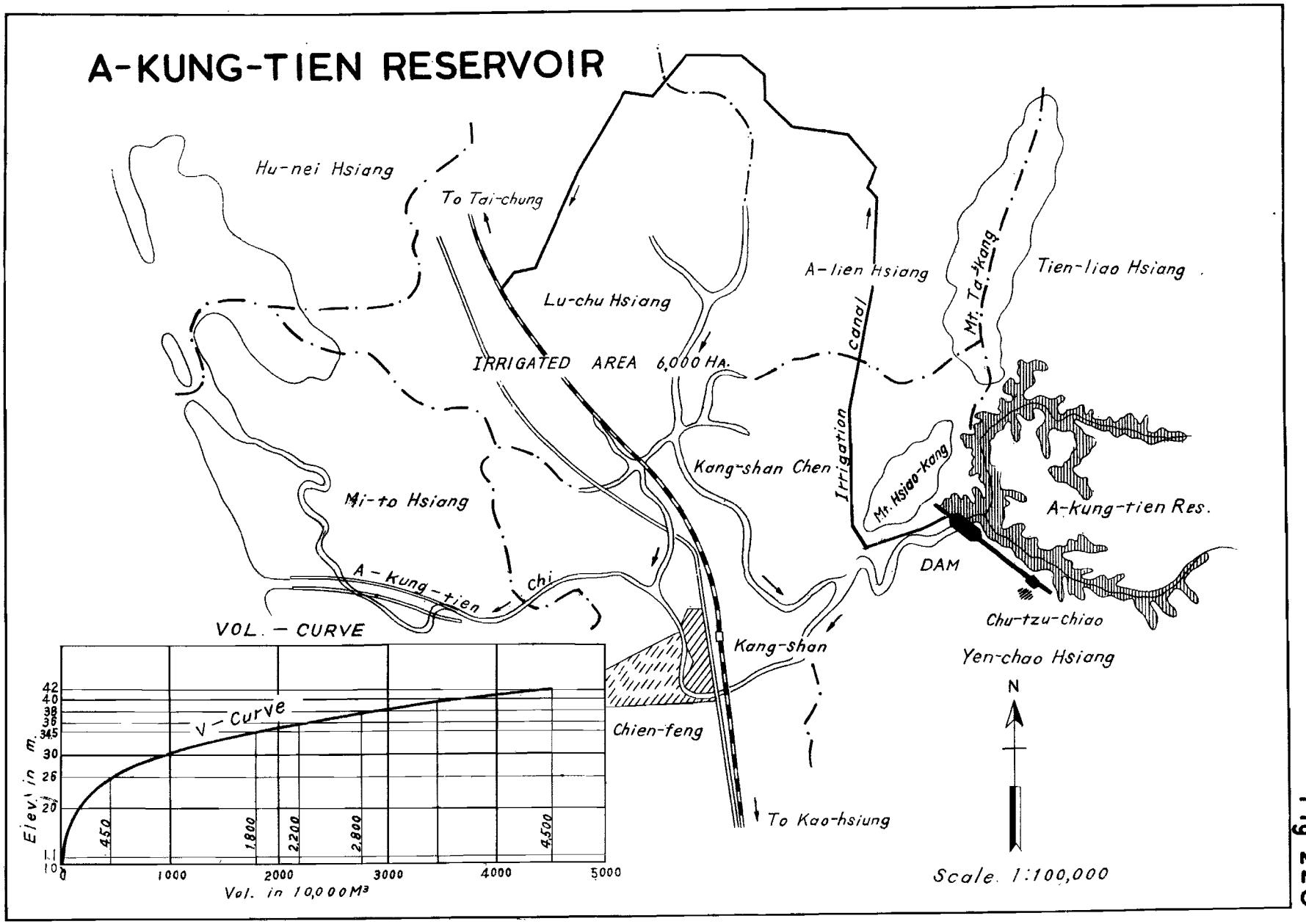

A-KUNG-TIEN RESERVOIR
Hu-nei Hsiang
To Tai-chung
Lu-chu Hsiang
IRRIGATED AREA 6,000 HA.
A-lien Hsiang
Irrigation canal
Mt. Ta-kang
Tien-liao Hsiang
Mt. Hsiao-kang
A-kung-tien Res.
DAM
Kang-shan Chen
Mi-to Hsiang
A-Kung-tien chi
Chu-tzu-chiao
Yen-chao Hsiang
Kang-shan
Chien-feng
To Kao-hsiung
N
Scale 1:100,000
VOL. — CURVE
V-Curve
Elev. in m.
Vol. in 10,000 M³
450
1800
2200
2800
4500

Fig 220

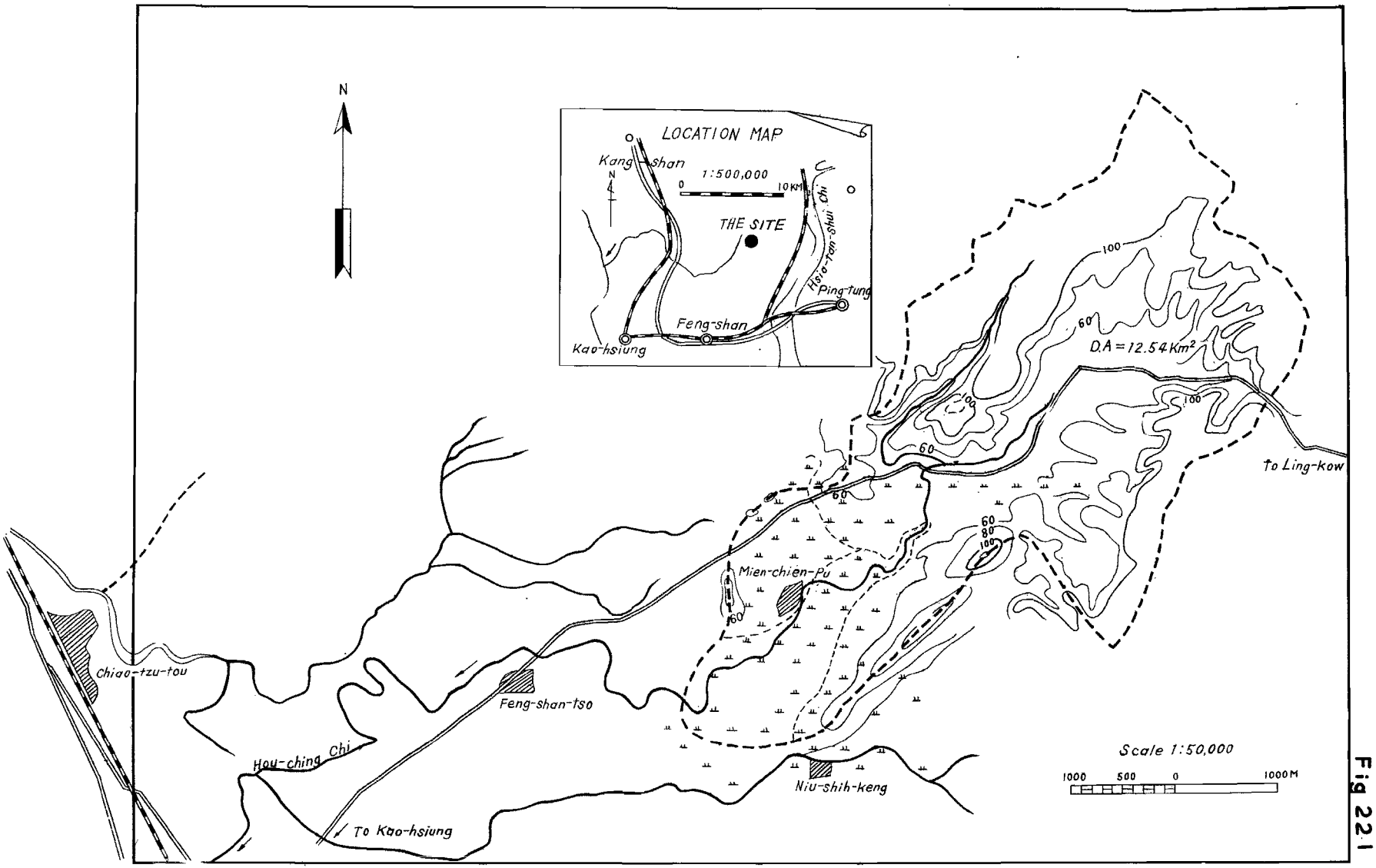

N
LOCATION MAP
Kang-shan
1:500,000
0 10KM
THE SITE
Hsia-tan-shui Chi
Ping-tung
Feng-shan
Kao-hsiung
D.A = 12.54 Km²
100
60
80
To Ling-kow
Mien-chien-pu
Chiao-tzu-tou
Feng-shan-tso
Hou-ching Chi
To Kao-hsiung
Niu-shih-keng
Scale 1:50,000
1000 500 0 1000M

Fig 22.1

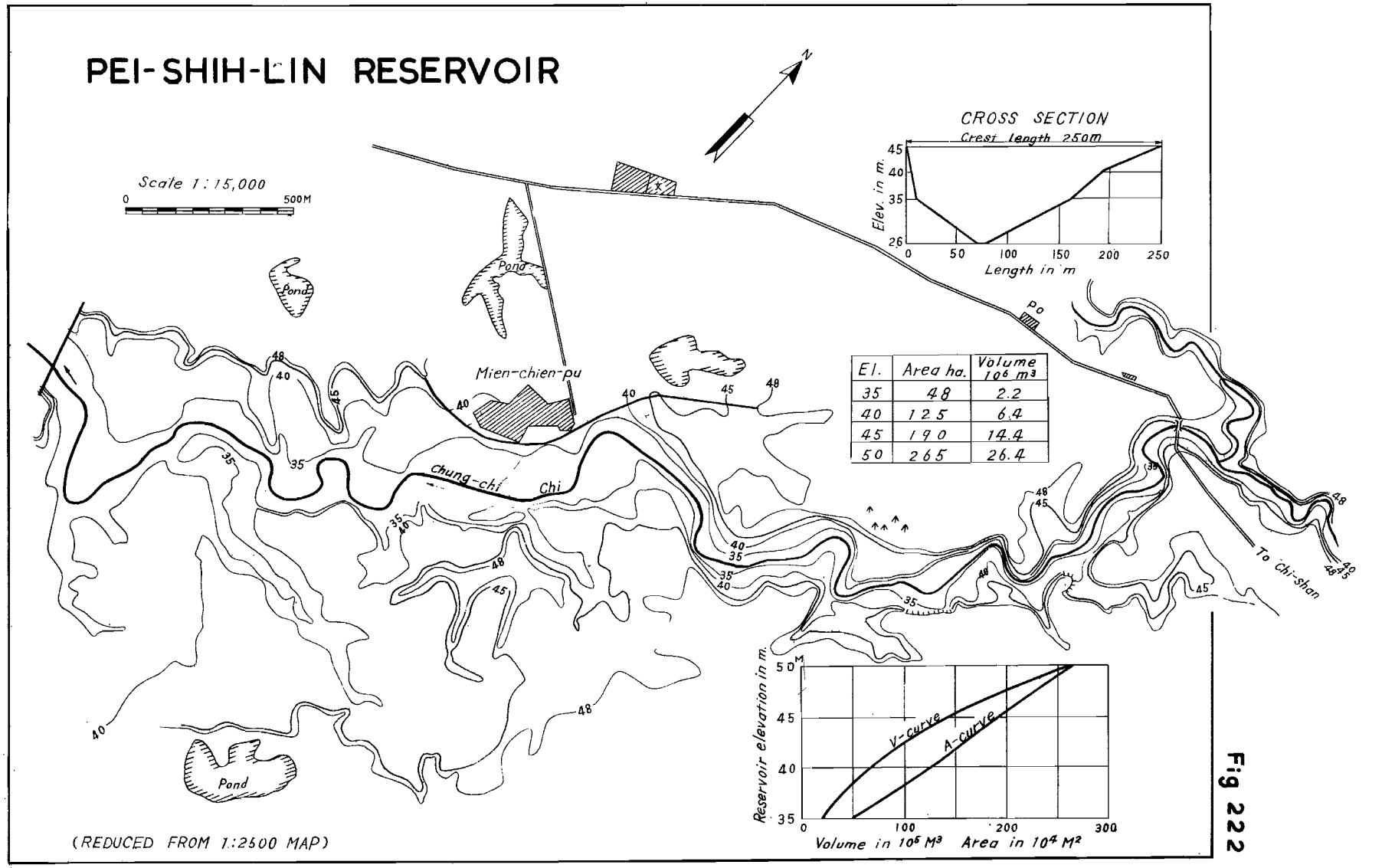
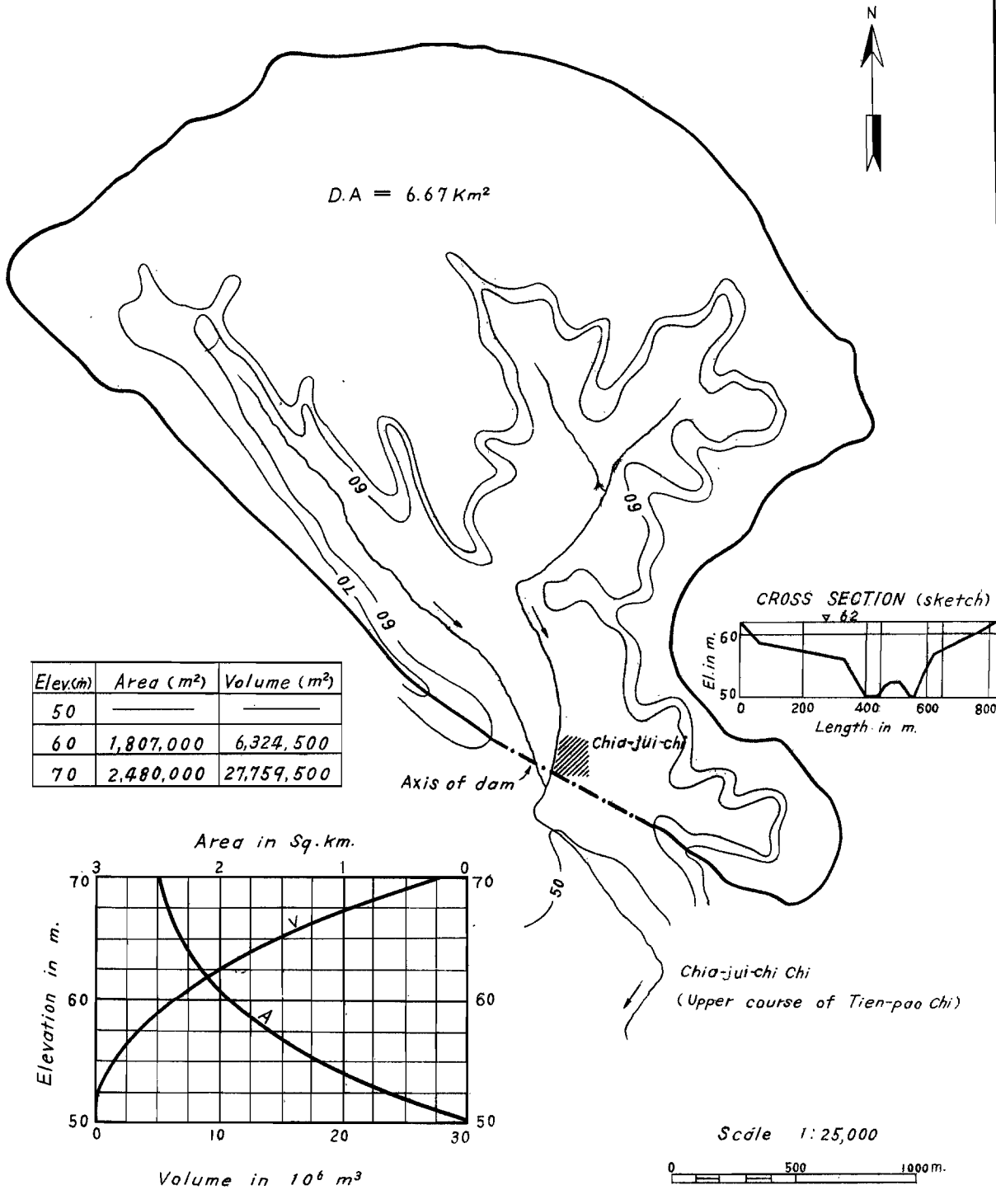

PEI-SHIH-LIN RESERVOIR
N
Scale 1 : 15,000
0
500M
CROSS SECTION
Crest length 250m
Elev. in m.
45
40
35
26
0
50
100
150
200
250
Length in m
Pond
Pond
Pond
Mien-chien-pu
Chung-chi
Chi
Po
To Chi-shan
El.
Area ha.
Volume 10⁶ m³
35
48
2.2
40
125
6.4
45
190
14.4
50
265
26.4
Reservoir elevation in m.
50M
45
40
35
V-curve
A-curve
0
100
200
300
Volume in 10⁵ M³
Area in 10⁴ M²
(REDUCED FROM 1:2500 MAP)

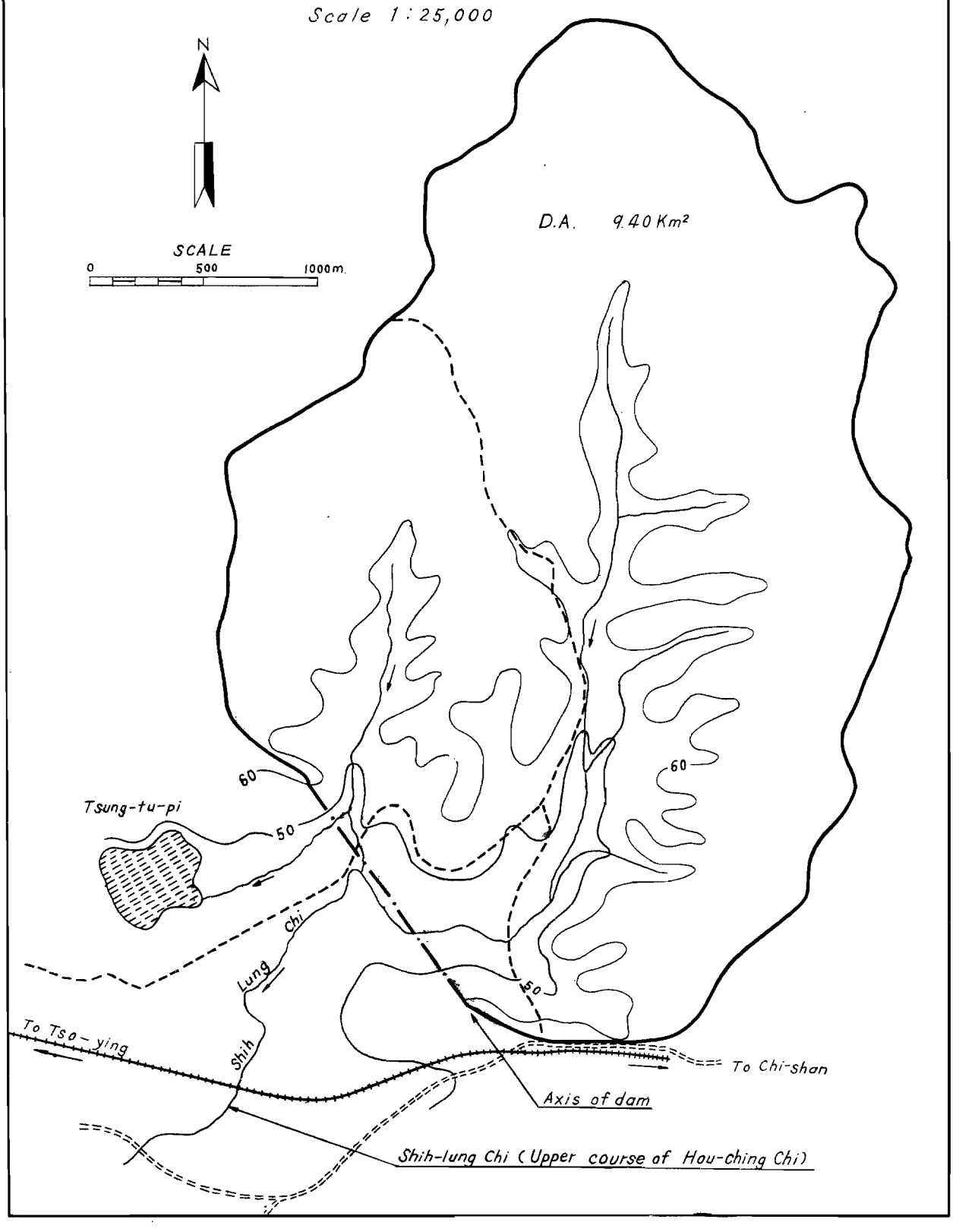
Fig 222

CHIA-JUI-CHI RESERVOIR

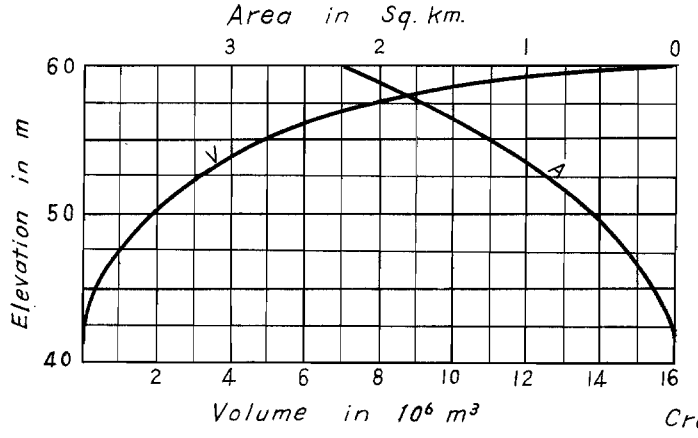


Elev.(m)	Area (m^2)	Volume (m^3)
50	——	——
60	1,807,000	6,324,500
70	2,480,000	27,759,500

SHIH-LUNG RESERVOIR

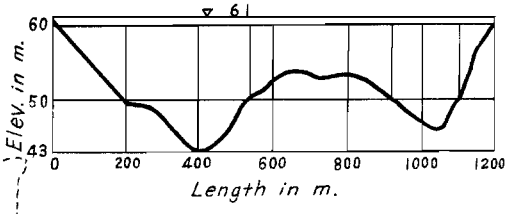


VOLUME AREA CURVE



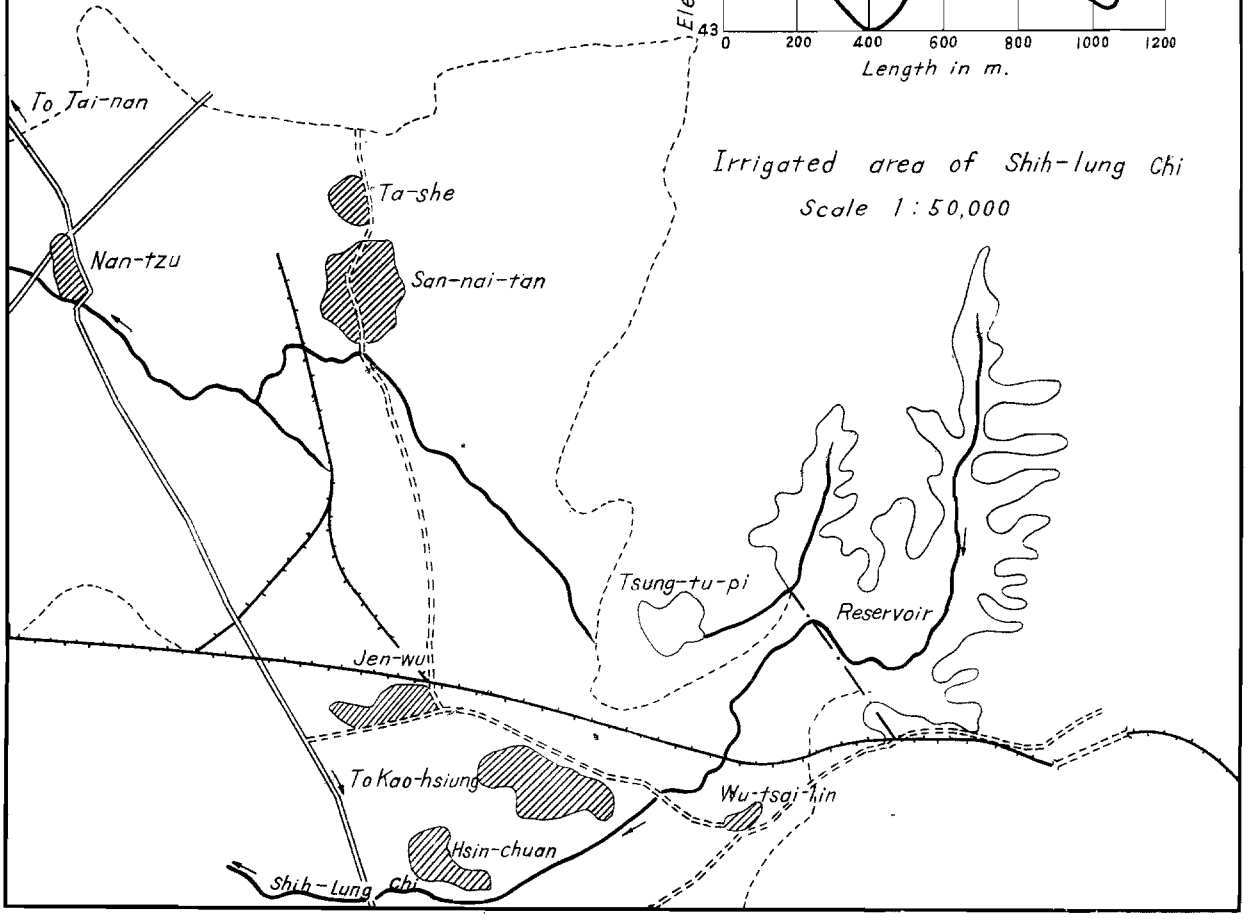
Elev.(m)	Area (m^2)	Vol. (m^3)
43	——	——
50	550,000	1,925,000
60	2,250,000	15,925,000

Cross section (sketch)

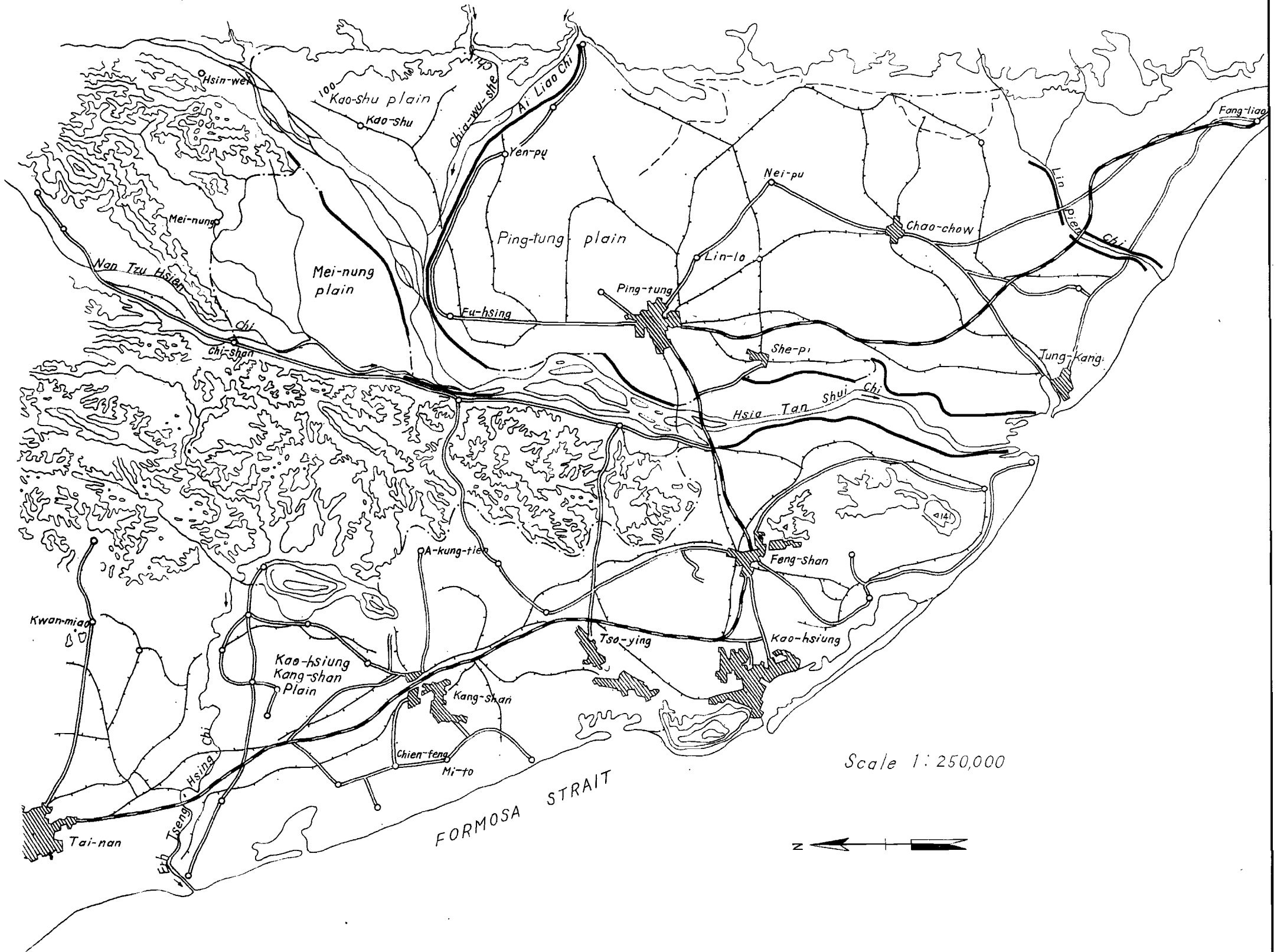


Irrigated area of Shih-lung Chi

Scale 1 : 50,000

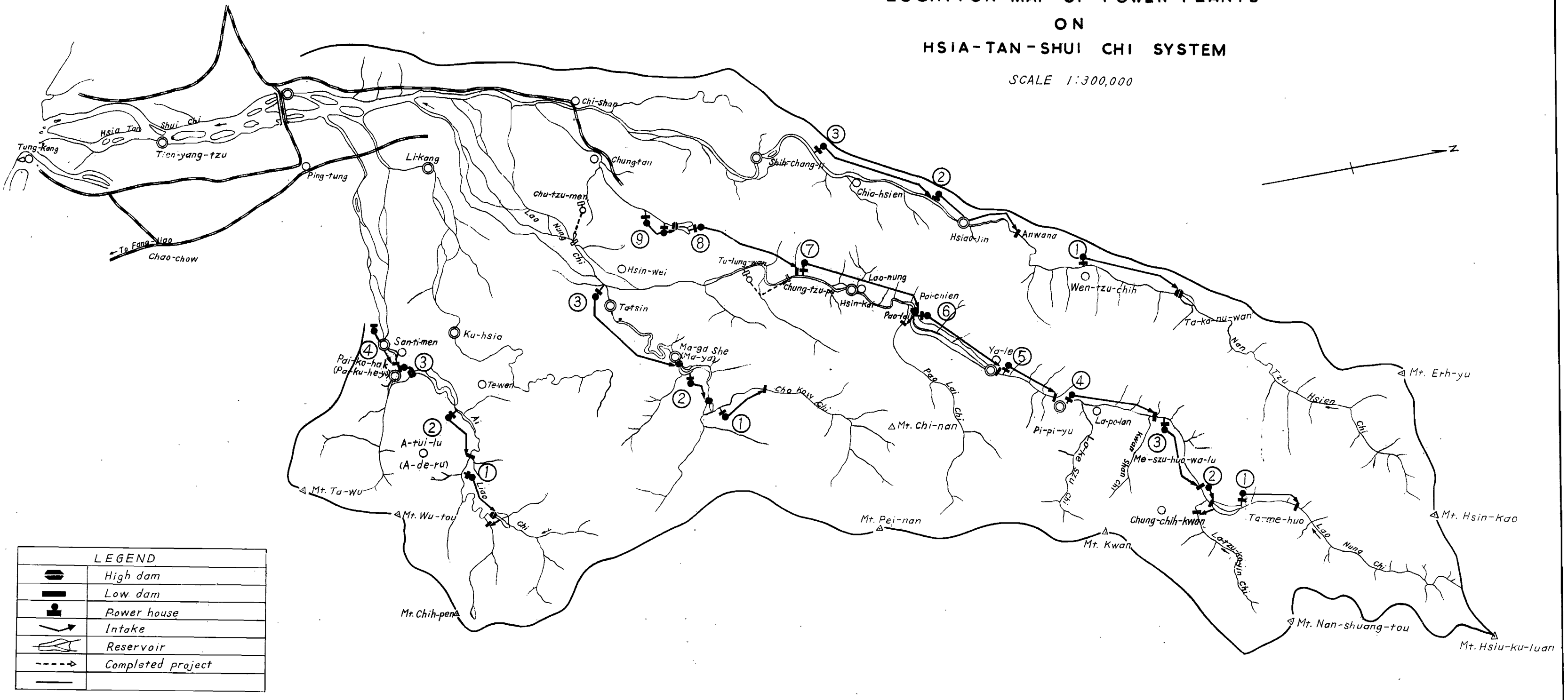


PLAINS ON THE LOWER COURSE OF HSIATANSHUI CHI BASIN



LOCATION MAP OF POWER PLANTS ON HSIA-TAN-SHUI CHI SYSTEM

SCALE 1:300,000



LEGEND	
	High dam
	Low dam
	Power house
	Intake
	Reservoir
----→	Completed project

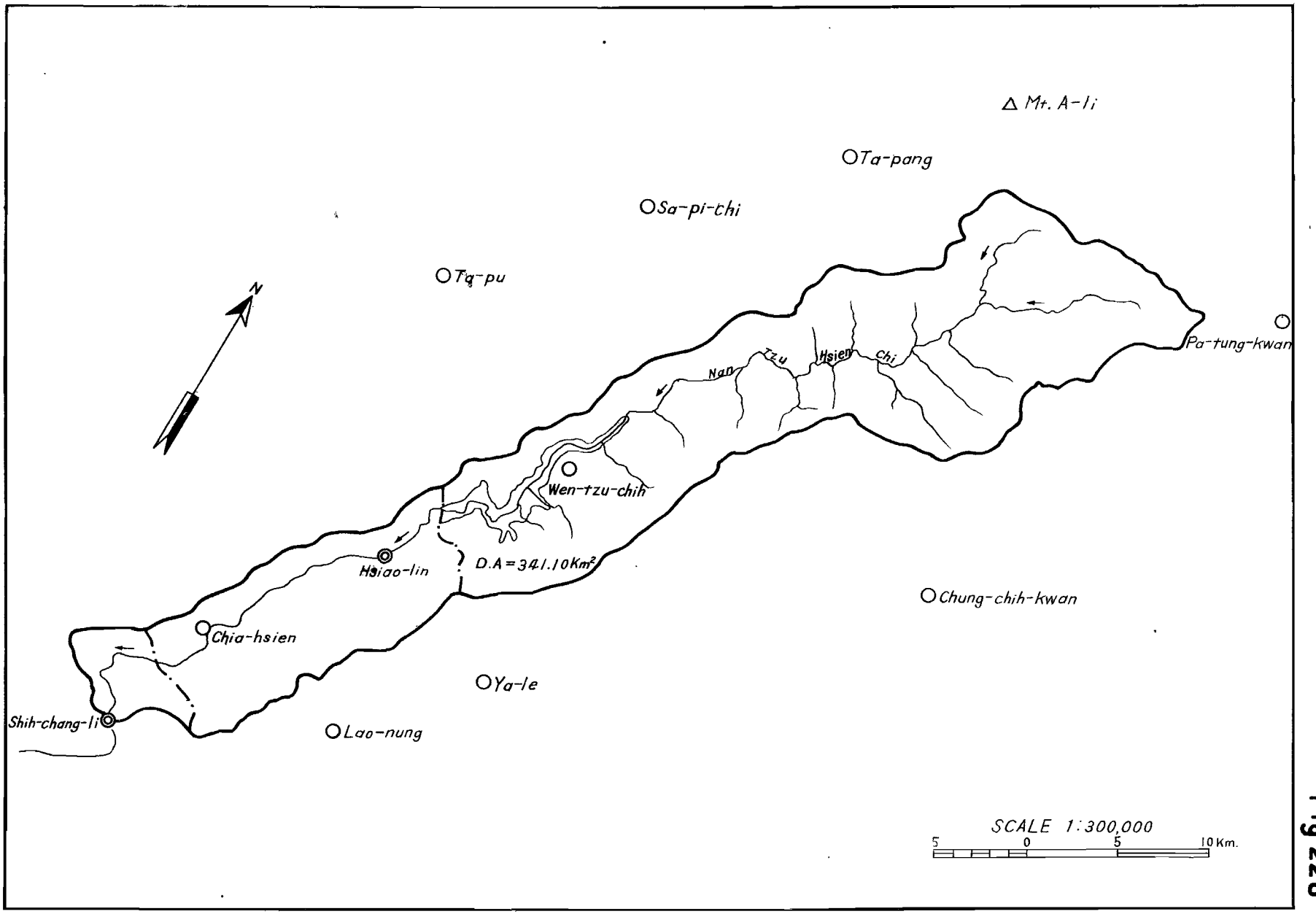

△ Mt. A-li
Ta-pang
Sa-pi-chi
Ta-pu
Pa-tung-kwan
Nan
Tzu
Hsien
Chi
Wen-tzu-chih
Hsiao-lin
D.A=341.10Km²
Chung-chih-kwan
Chia-hsien
Ya-le
Shih-chang-li
Lao-nung
N
SCALE 1:300,000
5 0 5 10 Km.

Fig 228

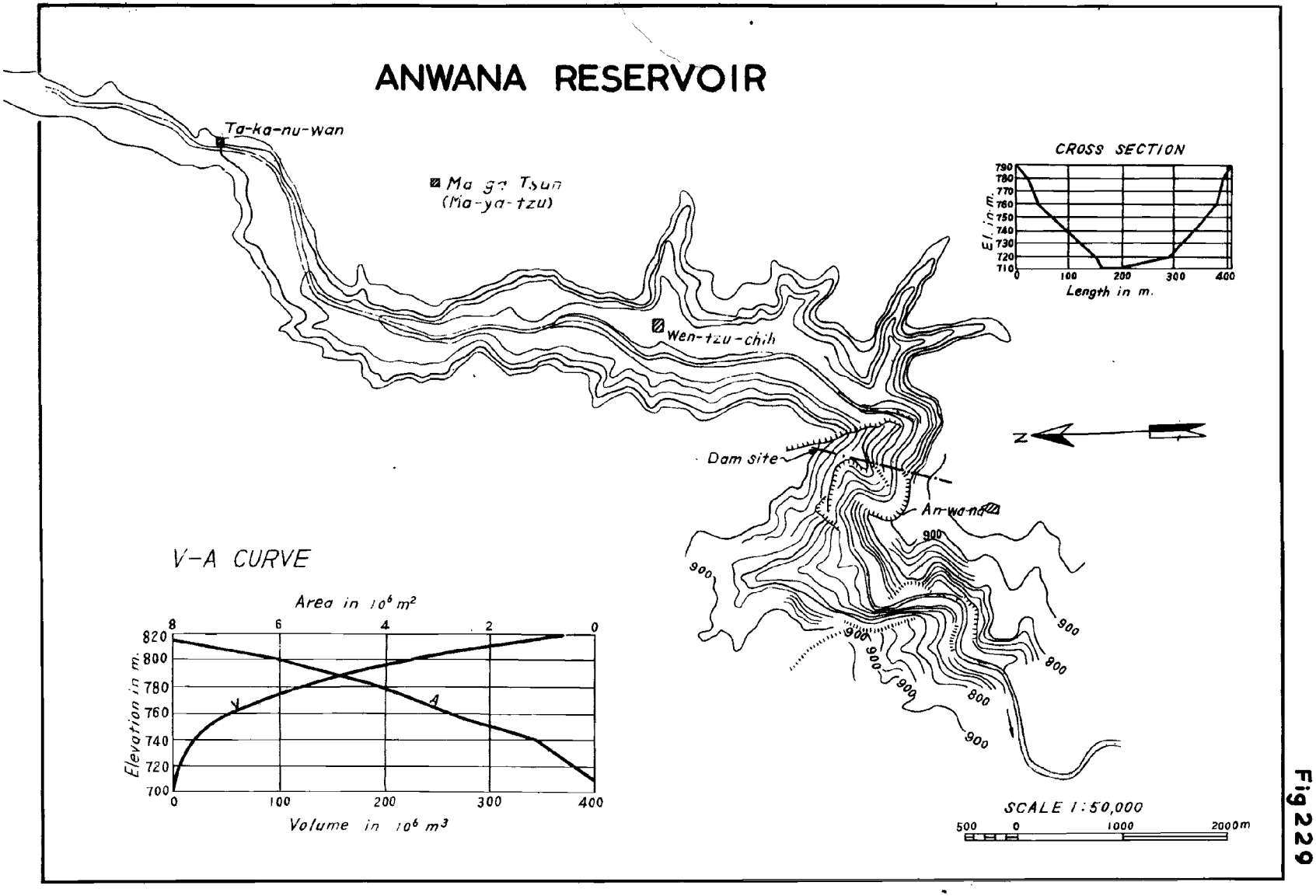
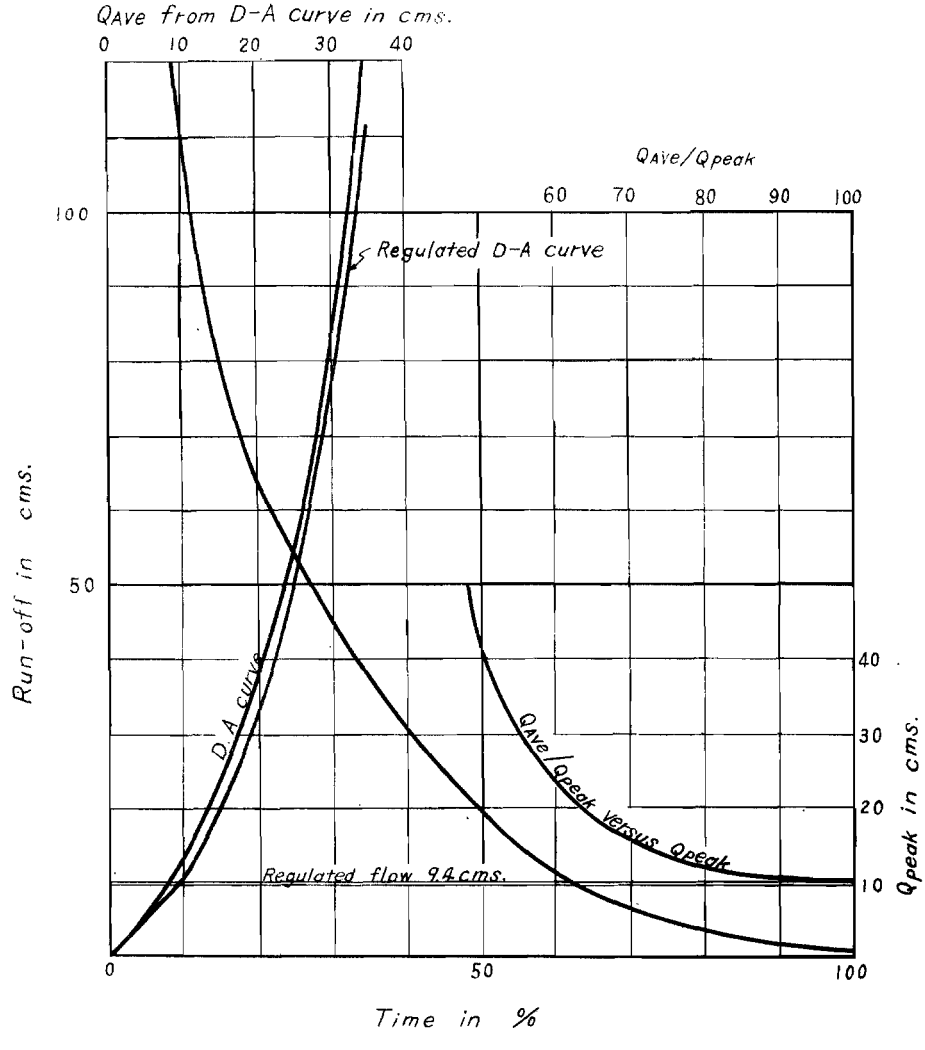

ANWANA RESERVOIR
Ta-ka-nu-wan
Ma ga Tsun
(Ma-ya-tzu)
Wen-tzu-chih
Dam site
An-wa-na
CROSS SECTION
El. in m.
790
780
770
760
750
740
730
720
710
0
100
200
300
400
Length in m.
N
V-A CURVE
Area in 10^6 m^2
8
6
4
2
0
820
800
780
760
740
720
700
Elevation in m.
V
A
0
100
200
300
400
Volume in 10^6 m^3
900
800
SCALE 1:50,000
500
0
1000
2000m

Fig 229

DURATION AREA CURVE



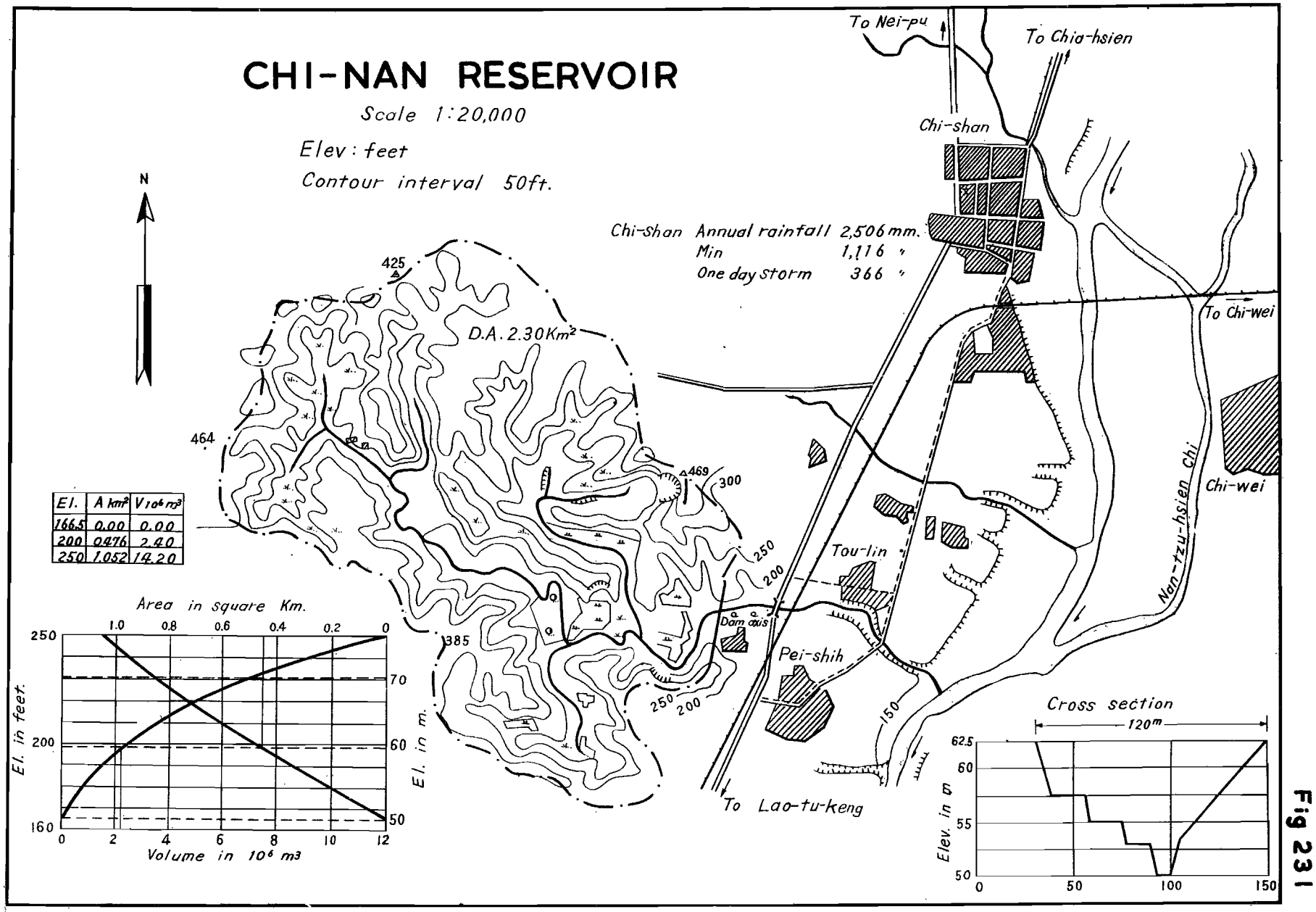

CHI-NAN RESERVOIR
Scale 1:20,000
Elev: feet
Contour interval 50ft.
N
To Nei-pu
To Chia-hsien
Chi-shan
Chi-Shan Annual rainfall 2,506 mm.
Min 1,116 "
One day storm 366 "
To Chi-wei
Chi-wei
Nan-tzu-hsien Chi
D.A. 2.30Km²
425
464
469
300
250
200
385
150
Tou-lin
Dam axis
Pei-shih
To Lao-tu-keng
El. | A km² | V 10⁶ m³
166.5 | 0.00 | 0.00
200 | 0.476 | 2.40
250 | 1.052 | 14.20
Area in square Km.
1.0 0.8 0.6 0.4 0.2 0
El. in feet.
250 200 160
El. in m.
70 60 50
0 2 4 6 8 10 12
Volume in 10⁶ m3
Cross section
120m
62.5 60 55 50
Elev. in m
0 50 100 150

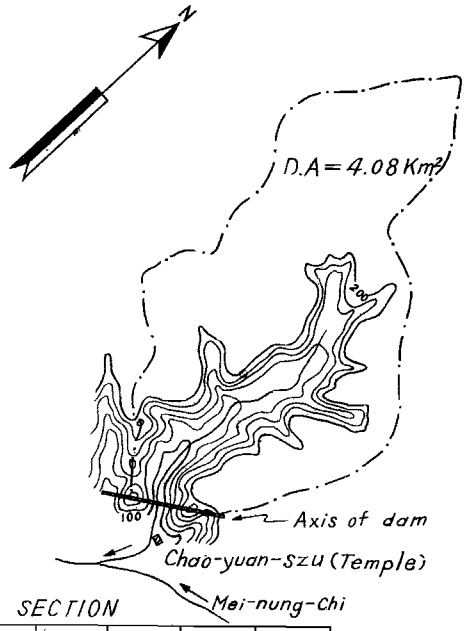
Fig 23 I

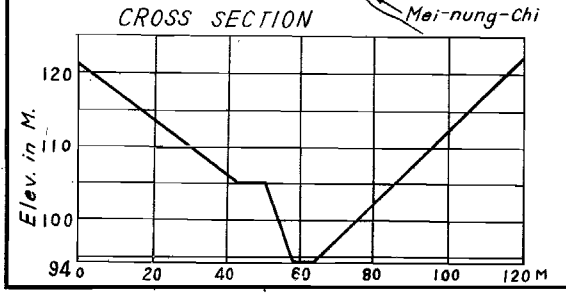
CHAO-YUAN-SZU RESERVOIR

VOLUME-AREA CURVE

Elev.(m)	Area (m^2)	Volume (m^3)
160	500,000	18,050,000
150	475,000	13,300,000
140	440,000	8,650,000
130	310,000	4,800,000
120	180,000	2,450,000
110	115,000	1,200,000
100	50,000	150,000
94	—	—

SCALE 1:50.000





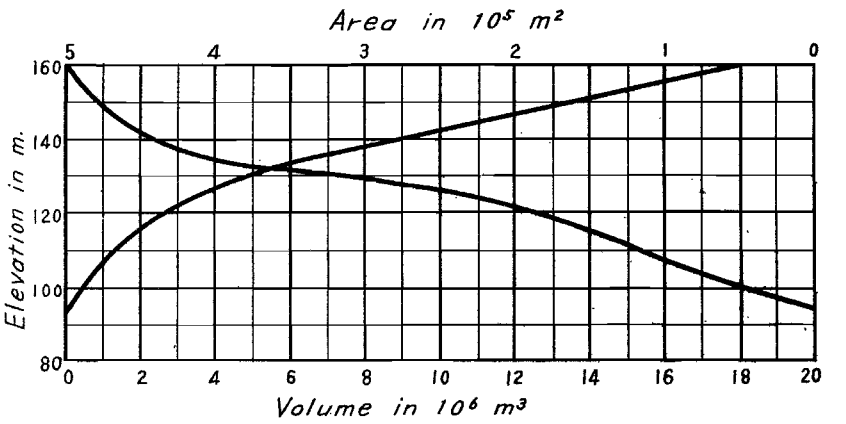
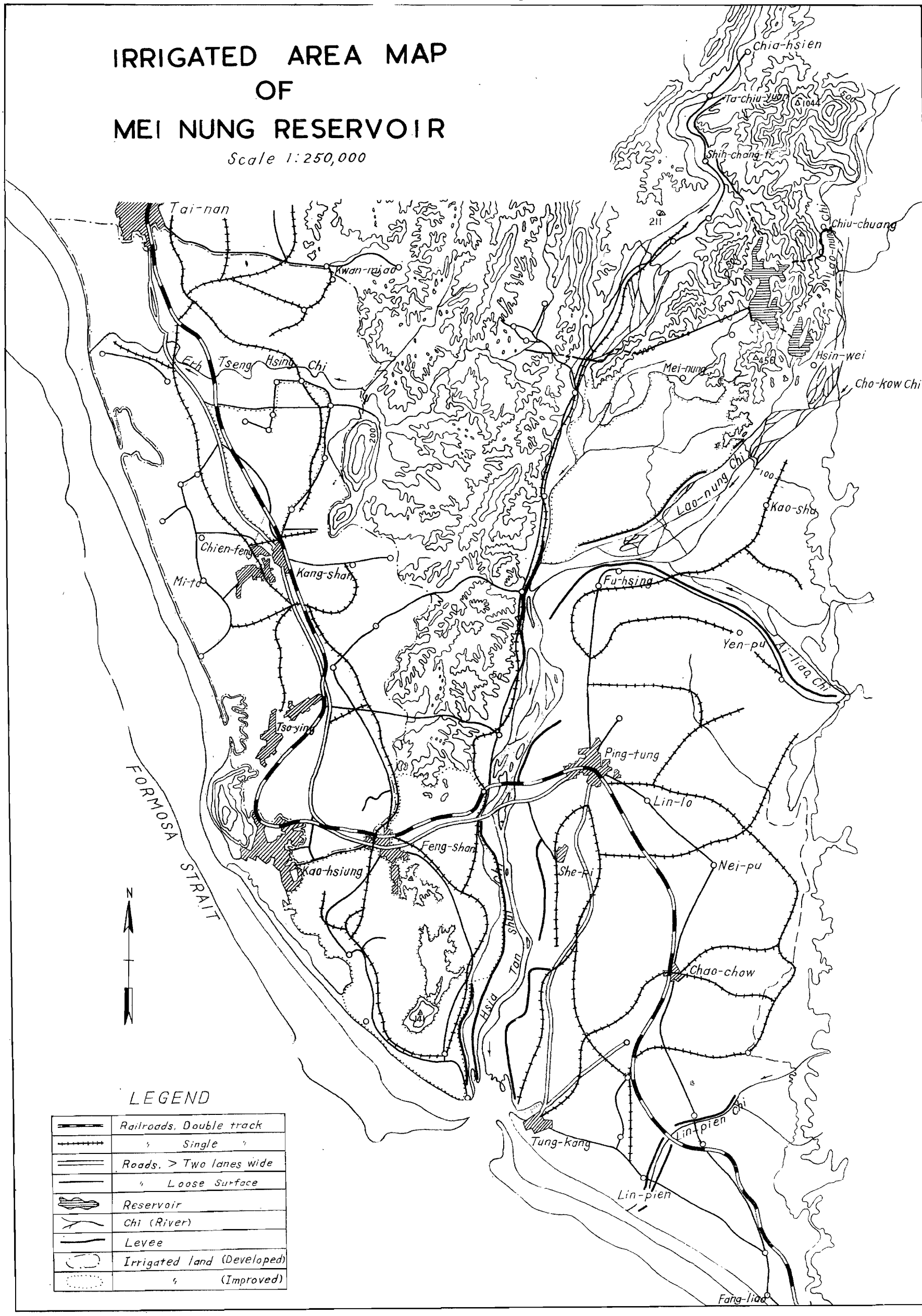


Fig 232

IRRIGATED AREA MAP OF MEI NUNG RESERVOIR

Scale 1:250,000

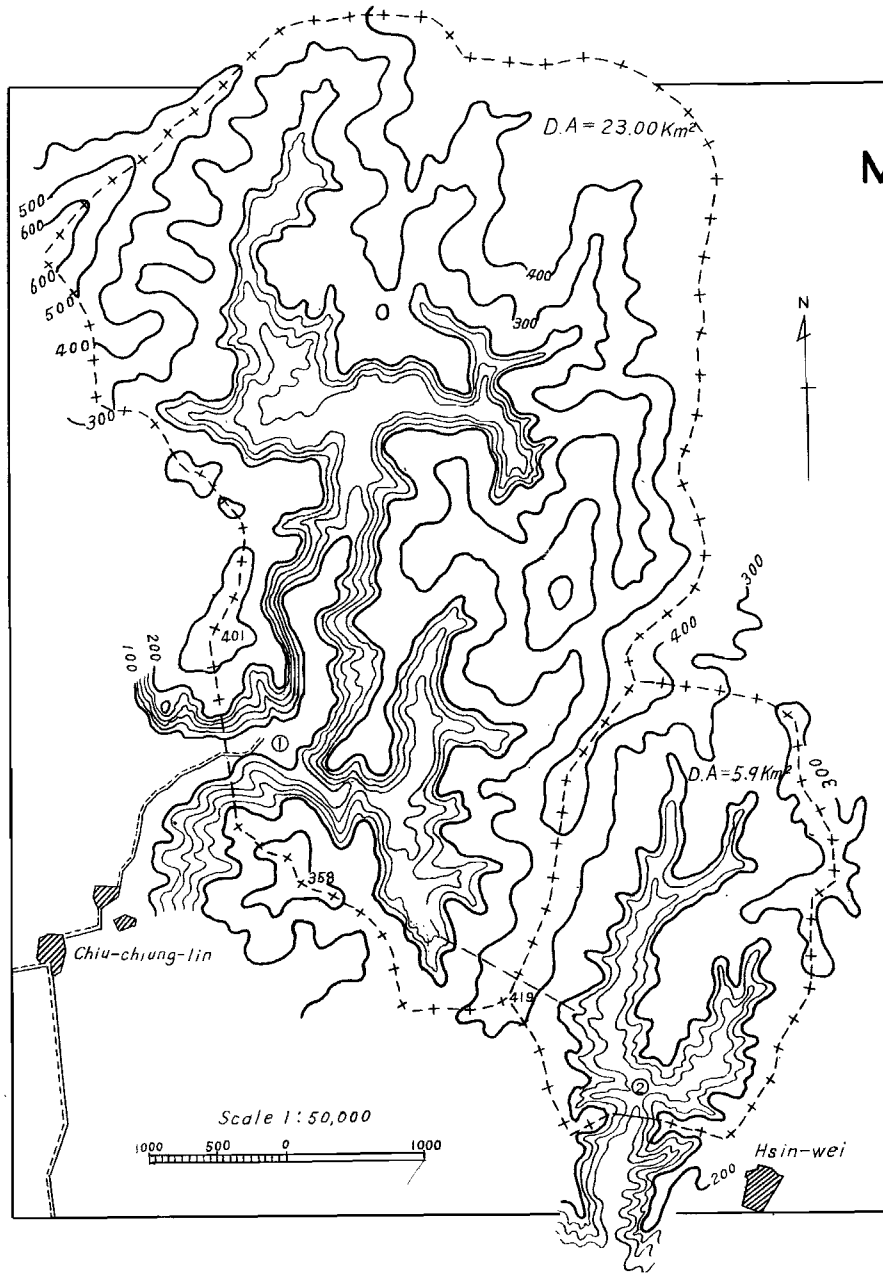


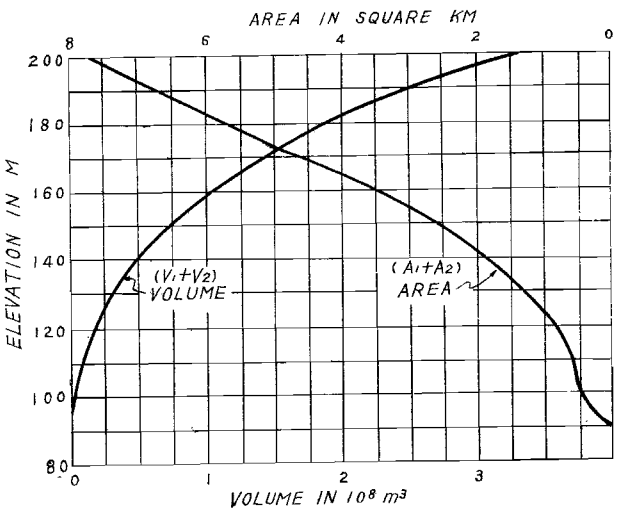
LEGEND

	Railroads, Double track
	" Single "
	Roads, > Two lanes wide
	" Loose Surface
	Reservoir
	Chi (River)
	Levee
	Irrigated land (Developed)
	" (Improved)

Fig 233

MEI-NUNG RESERVOIR

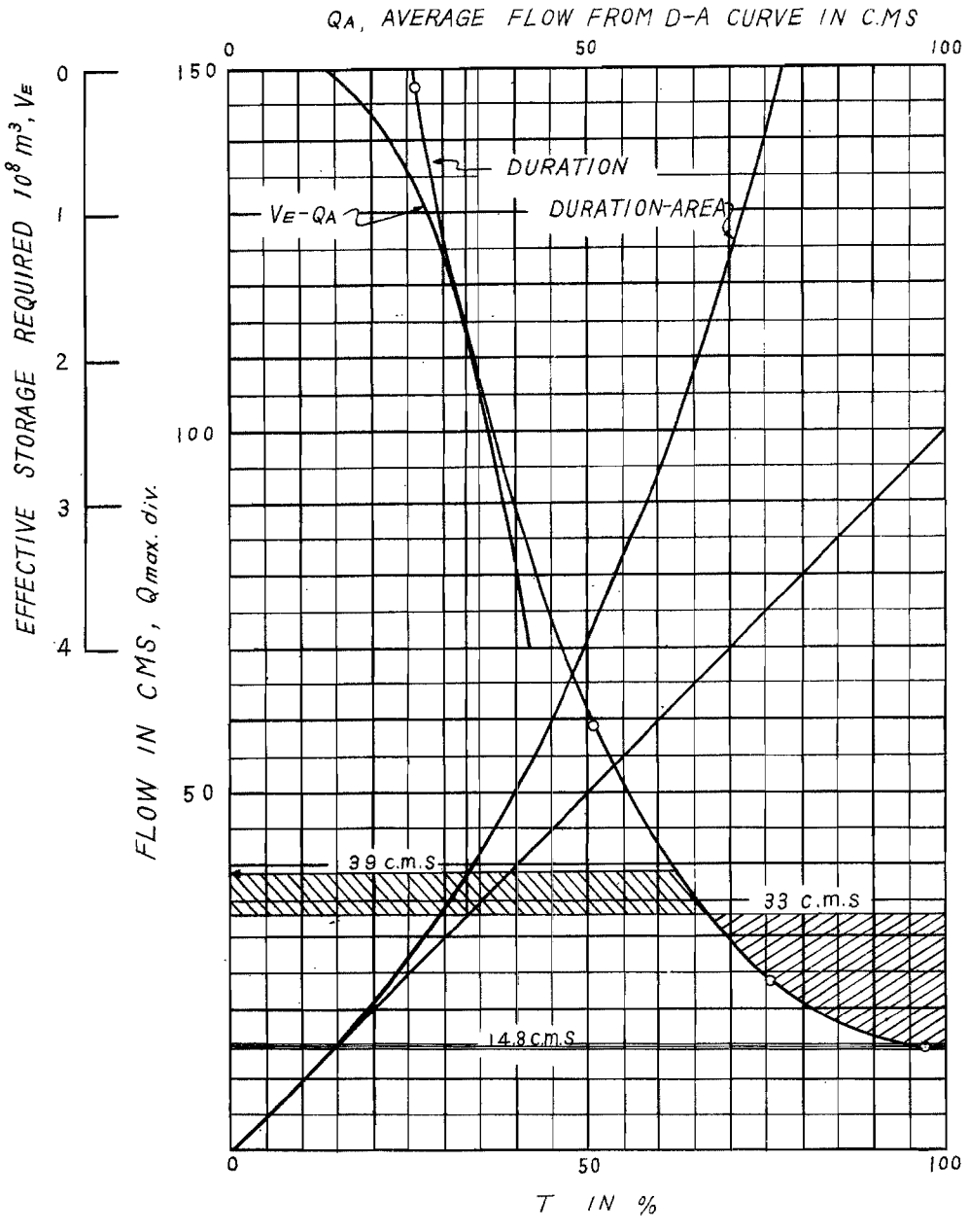




RES / Elev.	AREA Km² ①	②	Σ	VOLUME 10⁴M³ ①	②	Σ	RES / Elev.
90	0		0	0		0	90
100	0.54		0.54	5.4		5.4	100
120	0.82		0.82	19.0		19.0	120
140	1.96	0.02	1.98	47.8	0	47.8	140
160	3.02	0.40	3.42	97.6	4.2	101.8	160
180	4.78	0.94	5.72	175.6	17.6	193.2	180
200	6.06	1.58	7.64	284.0	42.8	3268	200

Fig 234

DURATION - AREA CURVE



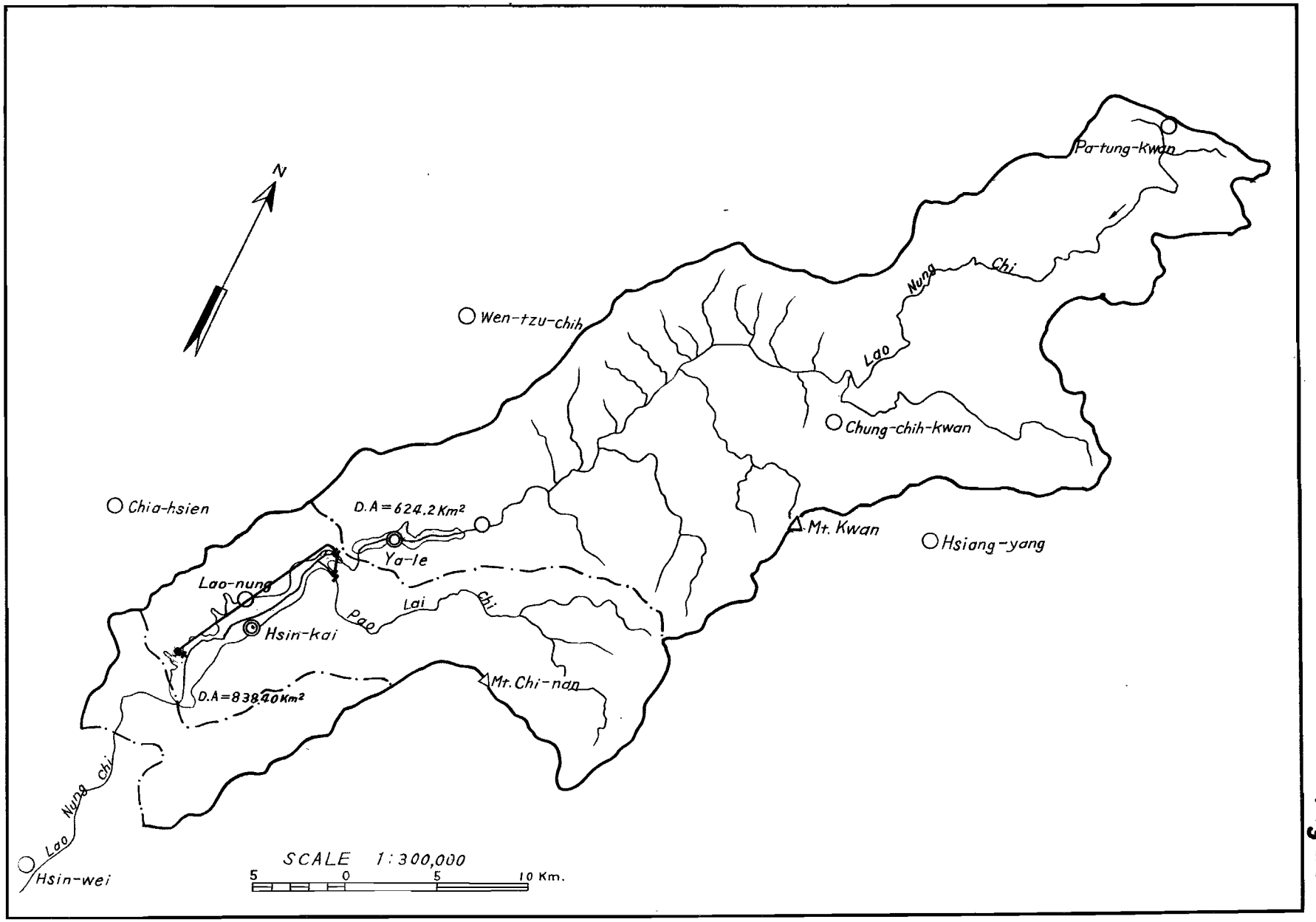
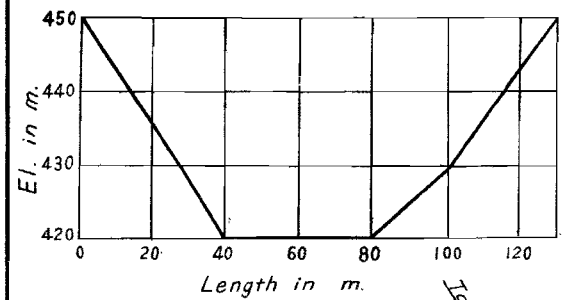
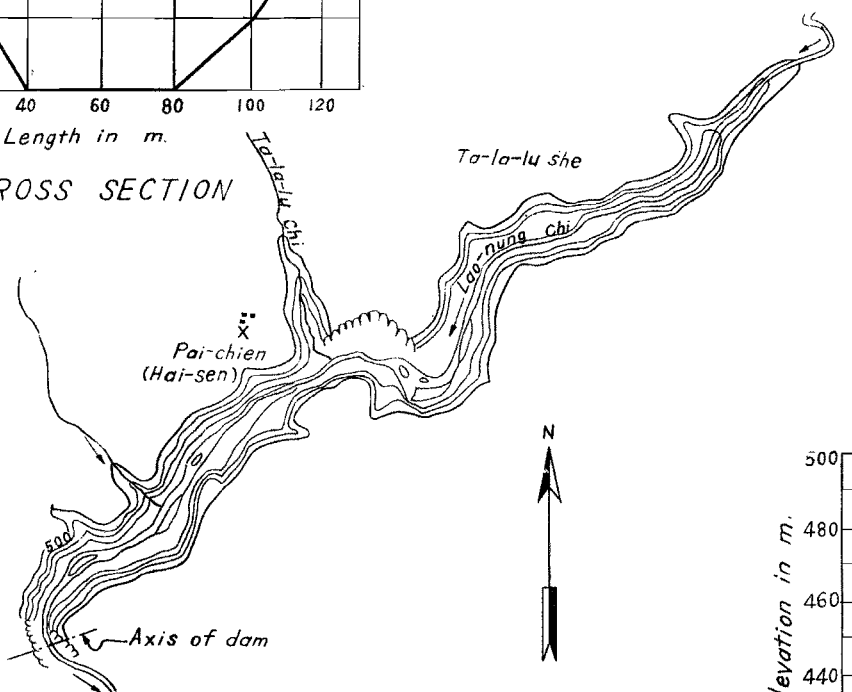

N
Pa-tung-kwan
Wen-tzu-chih
Lao Nung Chi
Chung-chih-kwan
Chia-hsien
D.A=624.2Km²
Ya-le
Mt. Kwan
Hsiang-yang
Lao-nung
Hsin-kai
Pao Lai Chi
Mt. Chi-nan
D.A=838.40Km²
Lao Nung Chi
Hsin-wei
SCALE 1:300,000
5 0 5 10 Km.

Fig 236

PAO-LAI RESERVOIR



CROSS SECTION



SCALE: 1:50,000

500 0 1000 2000 m.

VOLUME AREA CURVE

Elev.(m)	Area (Sq.Km)	Volume (10^6 m^3)
500	2.94	86.00
480	2.08	56.60
460	1.50	26.60
440	0.58	5.80
420	—	—

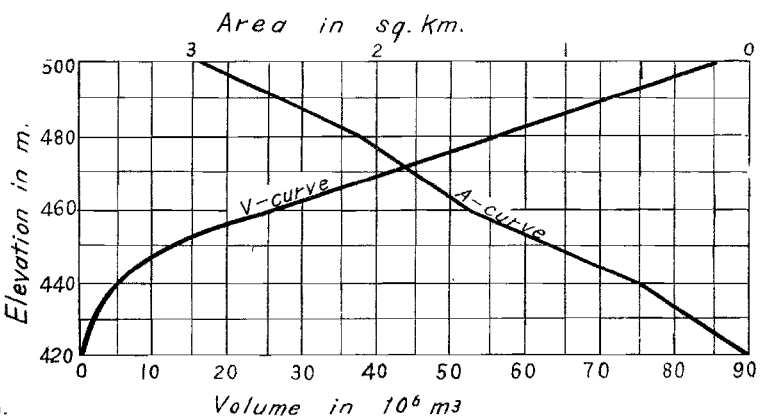
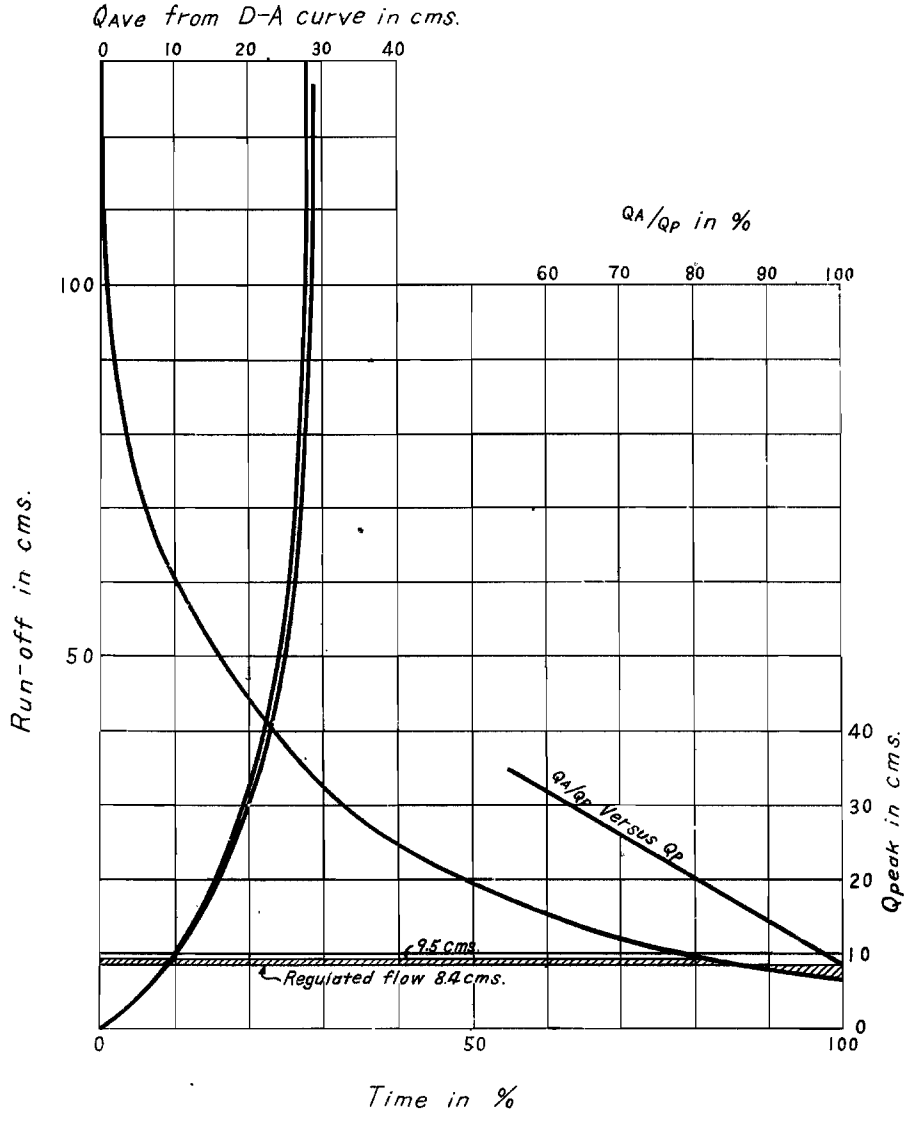
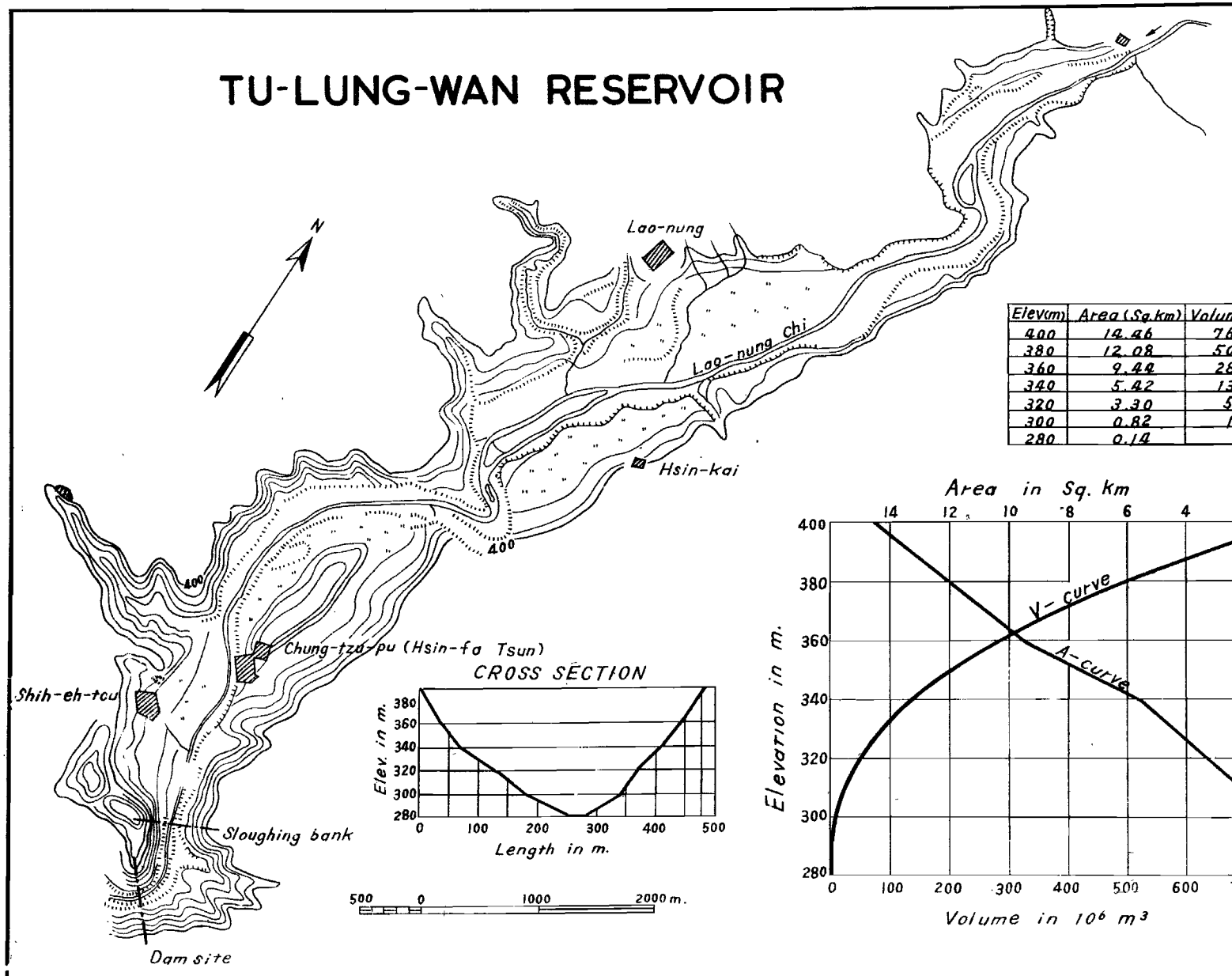


Fig 237

DURATION AREA CURVE



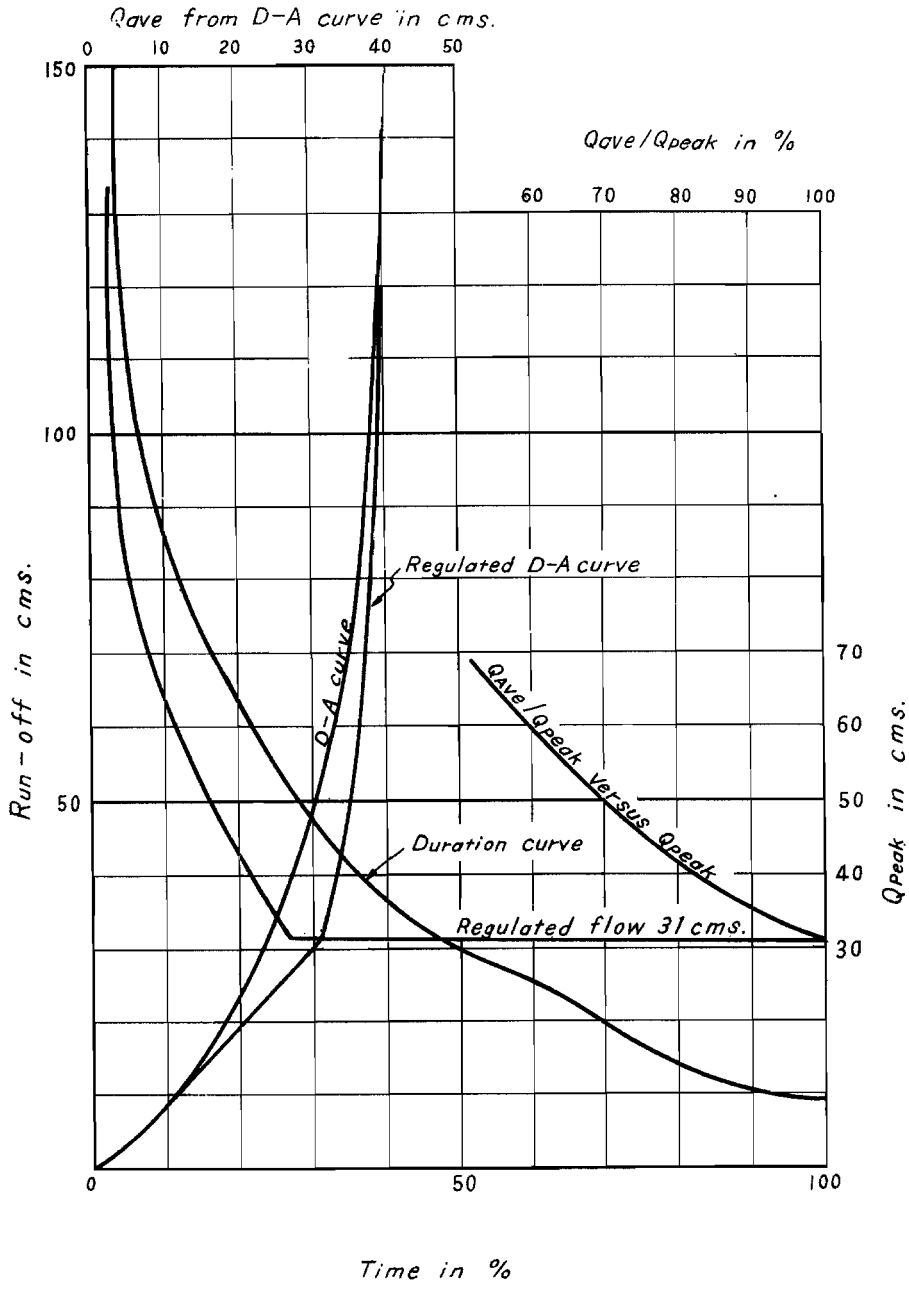
TU-LUNG-WAN RESERVOIR



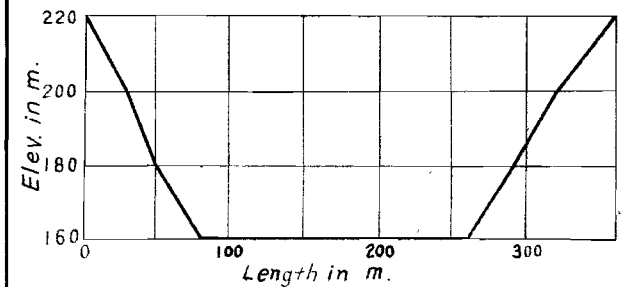
Elev.(m)	Area (Sq.km)	Volume($10^6 m^3$)
400	14.46	768.60
380	12.08	503.20
360	9.44	288.00
340	5.42	139.40
320	3.30	52.20
300	0.82	11.00
280	0.14	1.40

Fig 239

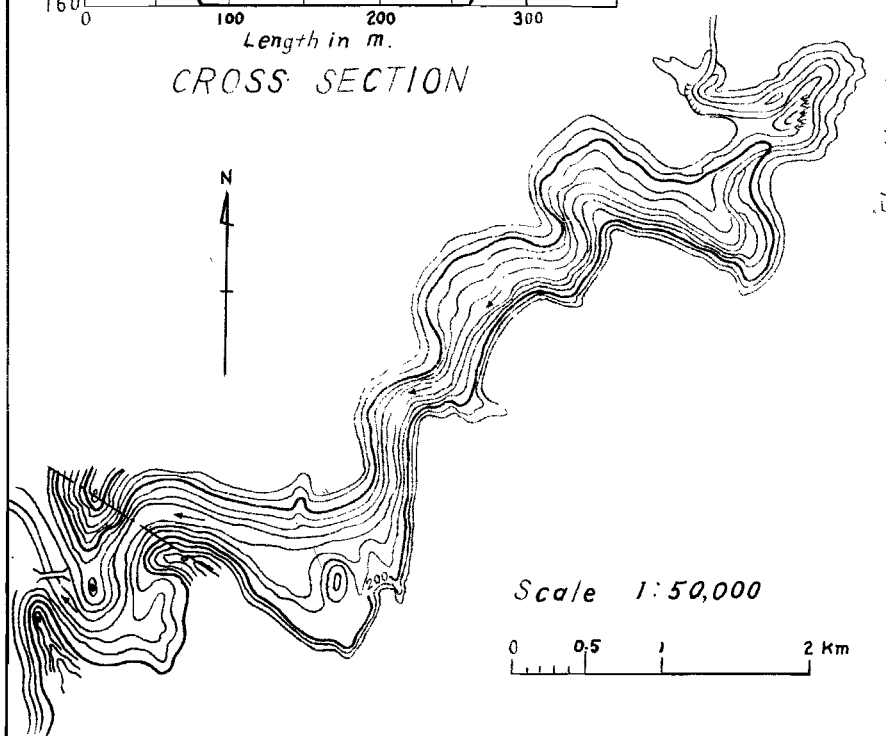
DURATION AREA CURVE



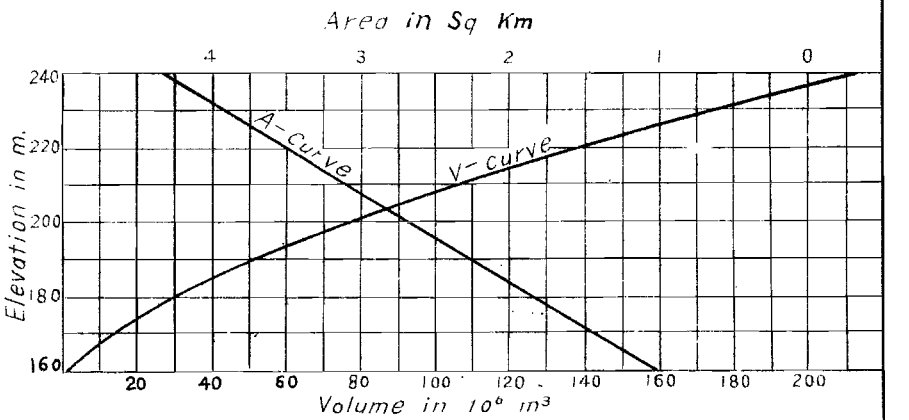
PLAN OF CHO-KOW RESERVOIR



CROSS SECTION



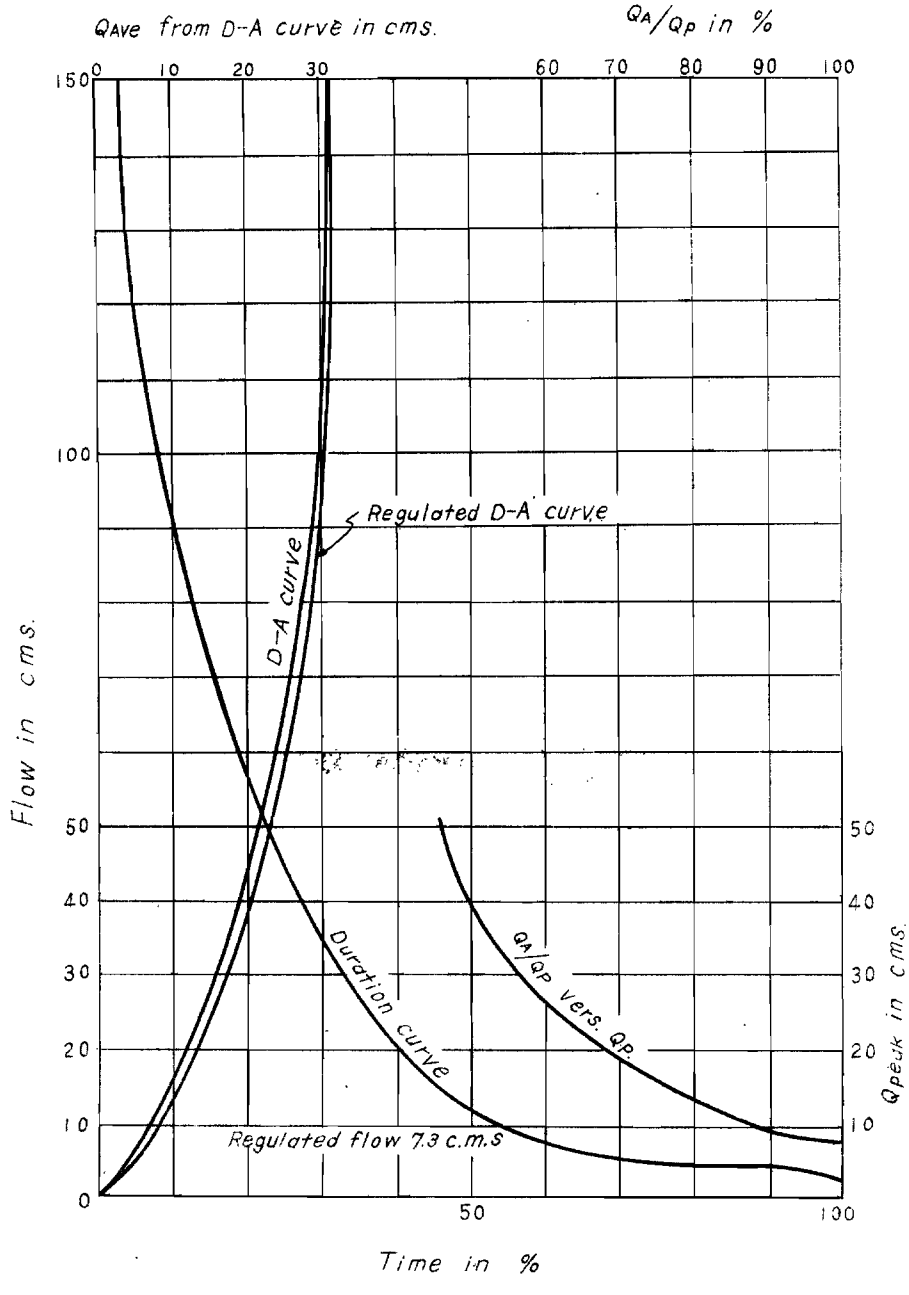
VOLUME—AREA CURVE



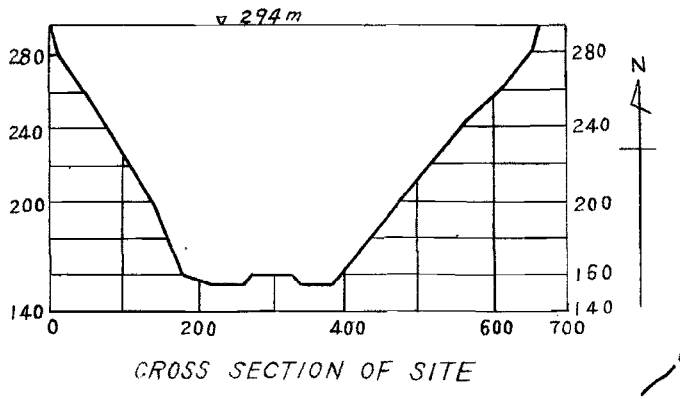
Elev (m)	Area (m²)	Volume (m³)
160	1,060,000	
180	1.880,000	29,400,000
200	2,660,000	74,800,000
220	3,510,000	136,500,000
240	4,290,000	214,500,000

Fig 24

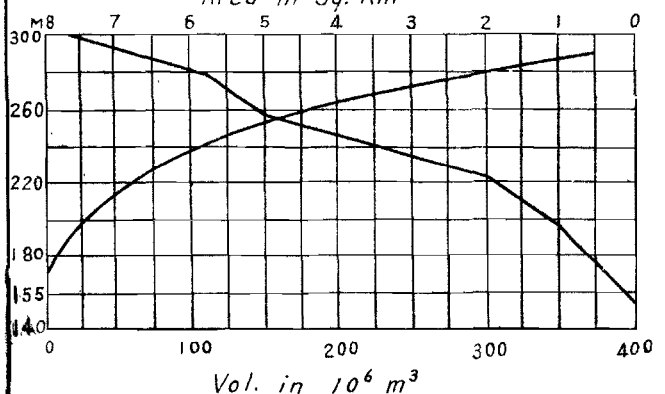
D - A CURVE


QAve from D-A curve in cms.
QA/Qp in %
0
10
20
30
60
70
80
90
100
150
100
50
40
30
20
10
0
Regulated D-A curve
D-A curve
Duration curve
QA/Qp vers. Qp.
Regulated flow 7.3 c.m.s
50
100
Time in %
Flow in cms.
Qpeak in cms.

AI-LIAO RESERVOIR



CROSS SECTION OF SITE



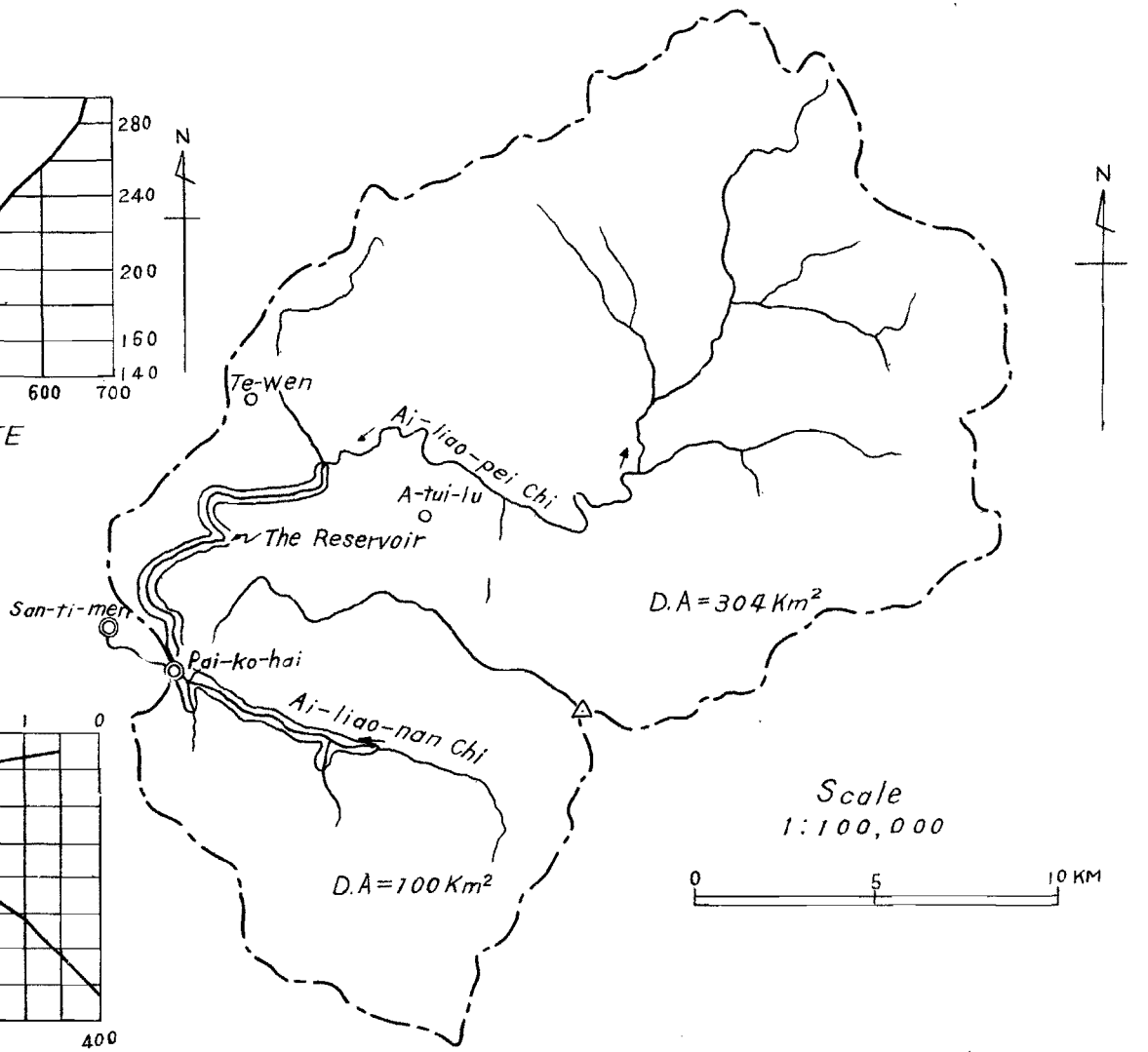
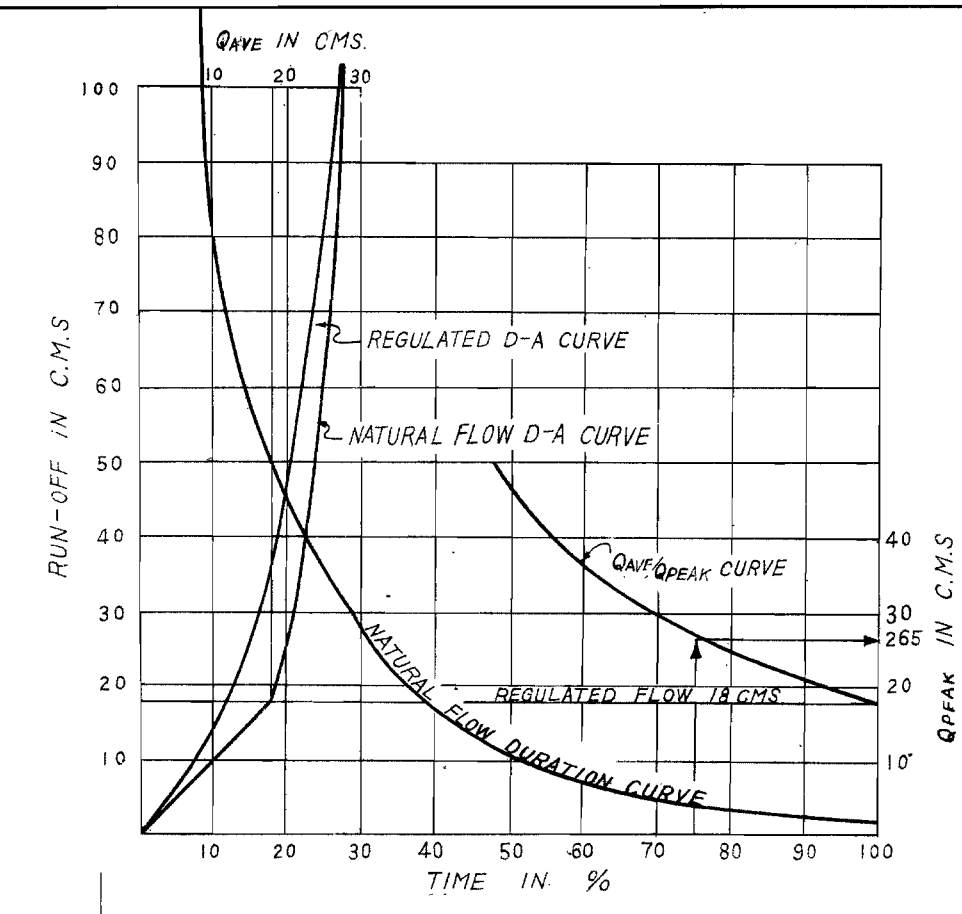
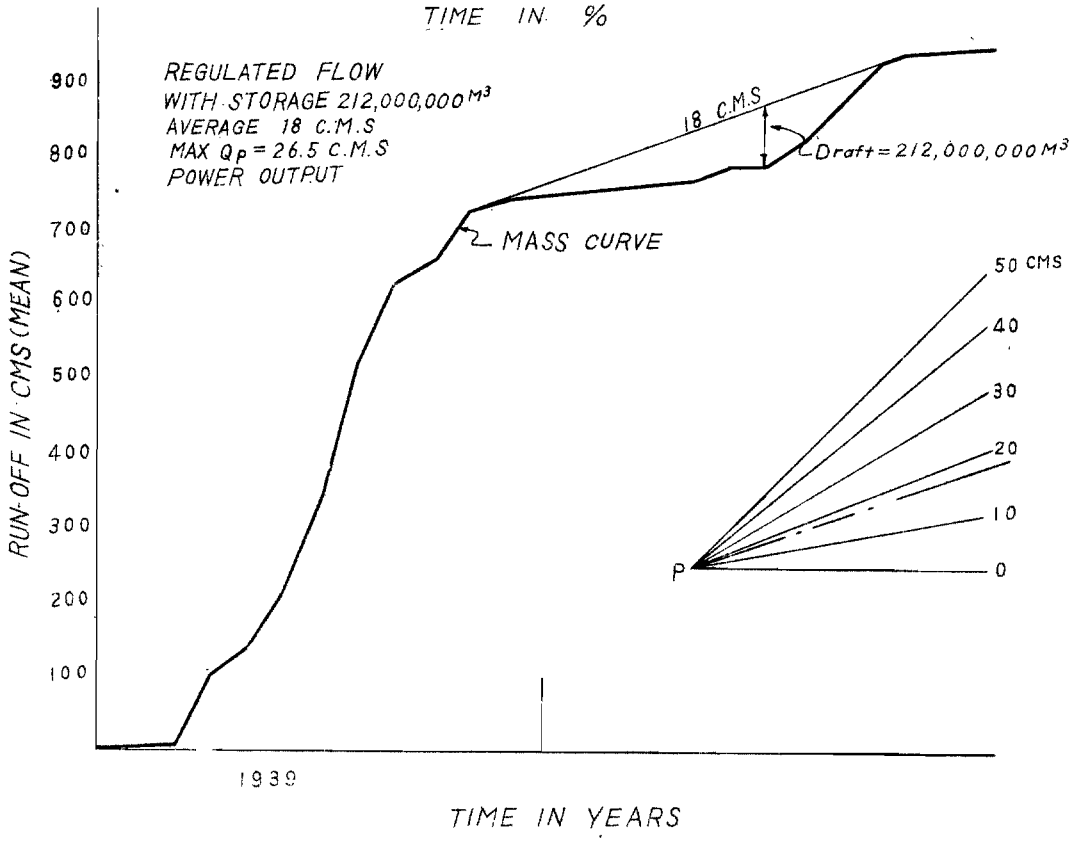
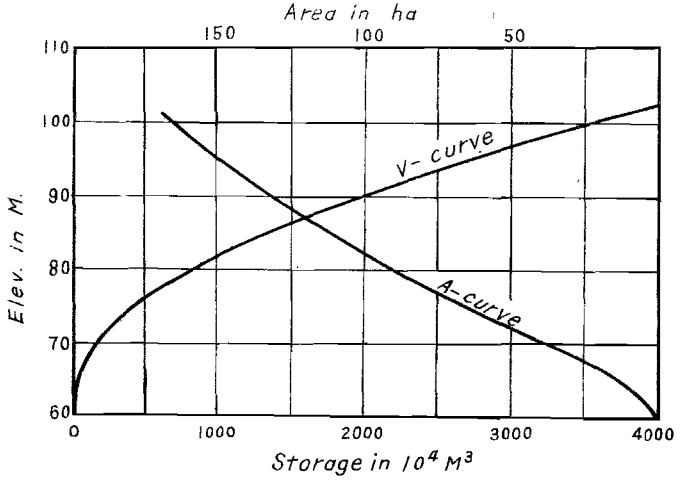


Fig 243


QAVE IN CMS.
10
20
30
100
90
80
70
60
50
40
30
20
10
RUN-OFF IN C.M.S
REGULATED D-A CURVE
NATURAL FLOW D-A CURVE
QAVE/QPEAK CURVE
NATURAL FLOW DURATION CURVE
REGULATED FLOW 18 CMS
40
30
265
20
10
QPEAK IN C.M.S
10
20
30
40
50
60
70
80
90
100
TIME IN %

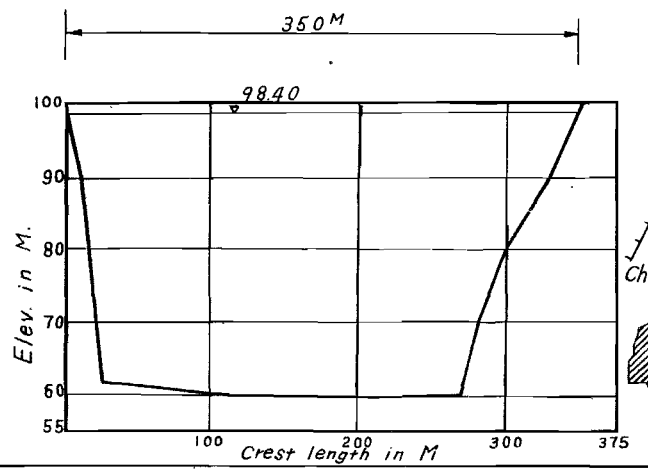

REGULATED FLOW
WITH STORAGE 212,000,000 M3
AVERAGE 18 C.M.S
MAX Qp = 26.5 C.M.S
POWER OUTPUT
18 C.M.S
Draft = 212,000,000 M3
MASS CURVE
50 CMS
40
30
20
10
0
P
900
800
700
600
500
400
300
200
100
RUN-OFF IN CMS (MEAN)
1939
TIME IN YEARS

LIANG - SHAN RESERVOIR



VOL. & AREA CURVE

CROSS SECTION



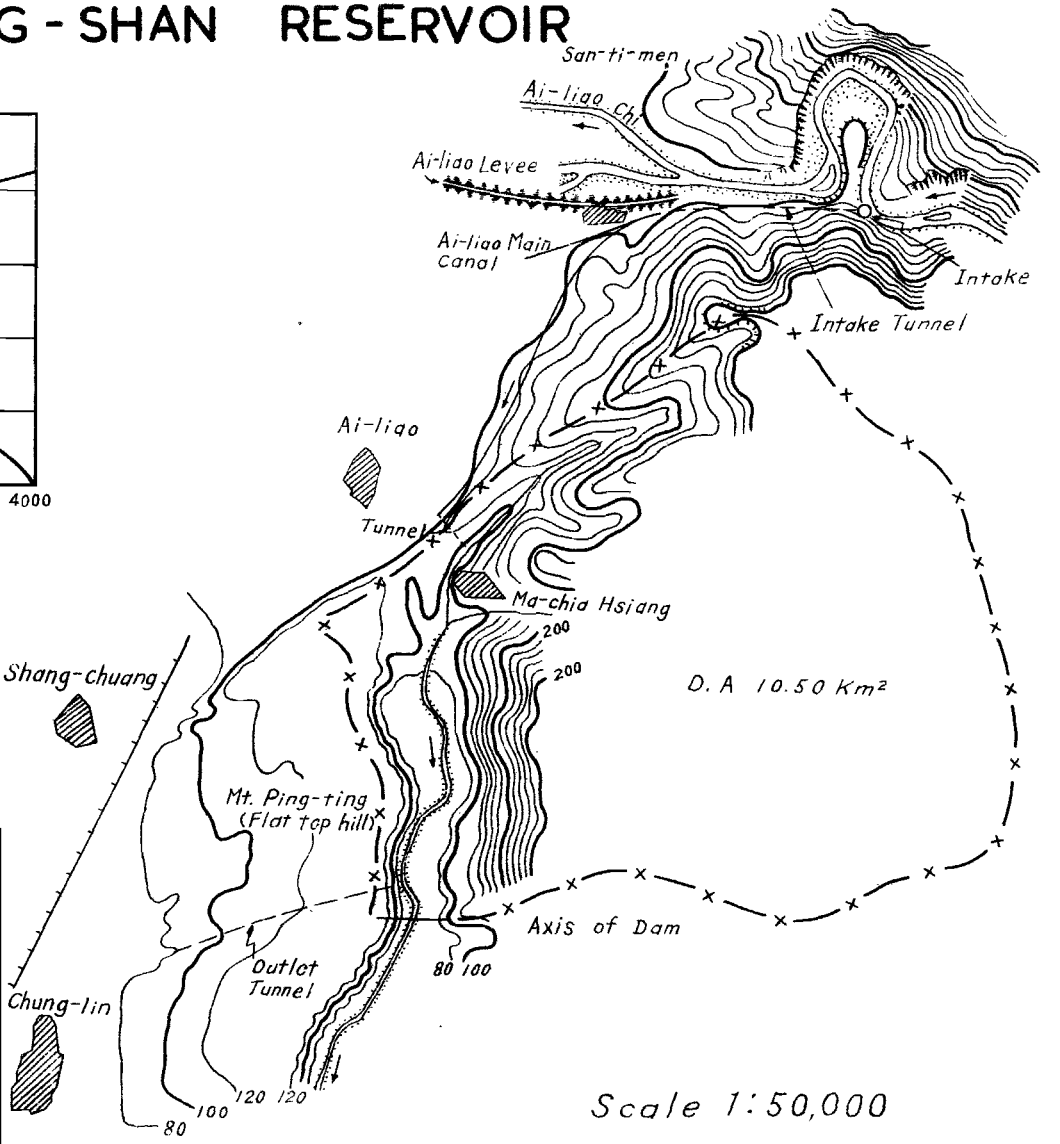
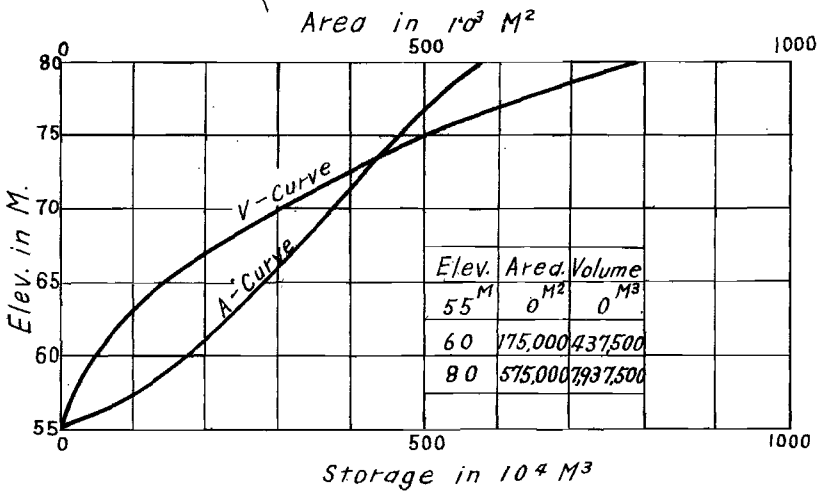


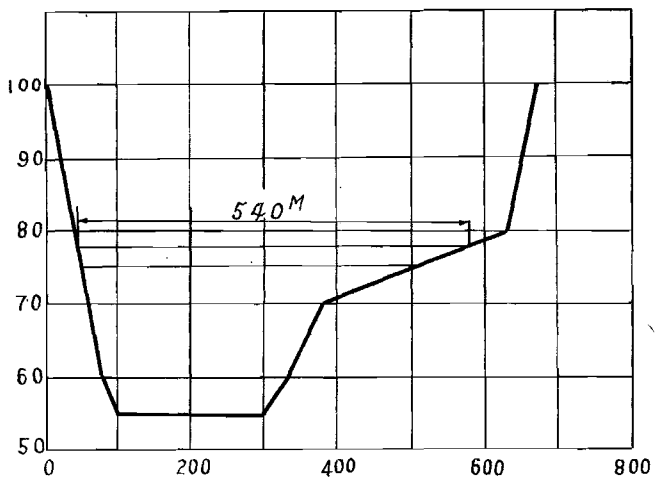
Fig 245

VOLUME ~ AREA CURVE



Elev.	Area	Volume
55 M	0 M²	0 M³
60	175,000	437,500
80	575,000	1,937,500

CROSS SECTION OF DAM SITE



LOCATION PLAN OF NAN-SHIH-HU RESERVOIR

Scale 1:50,000

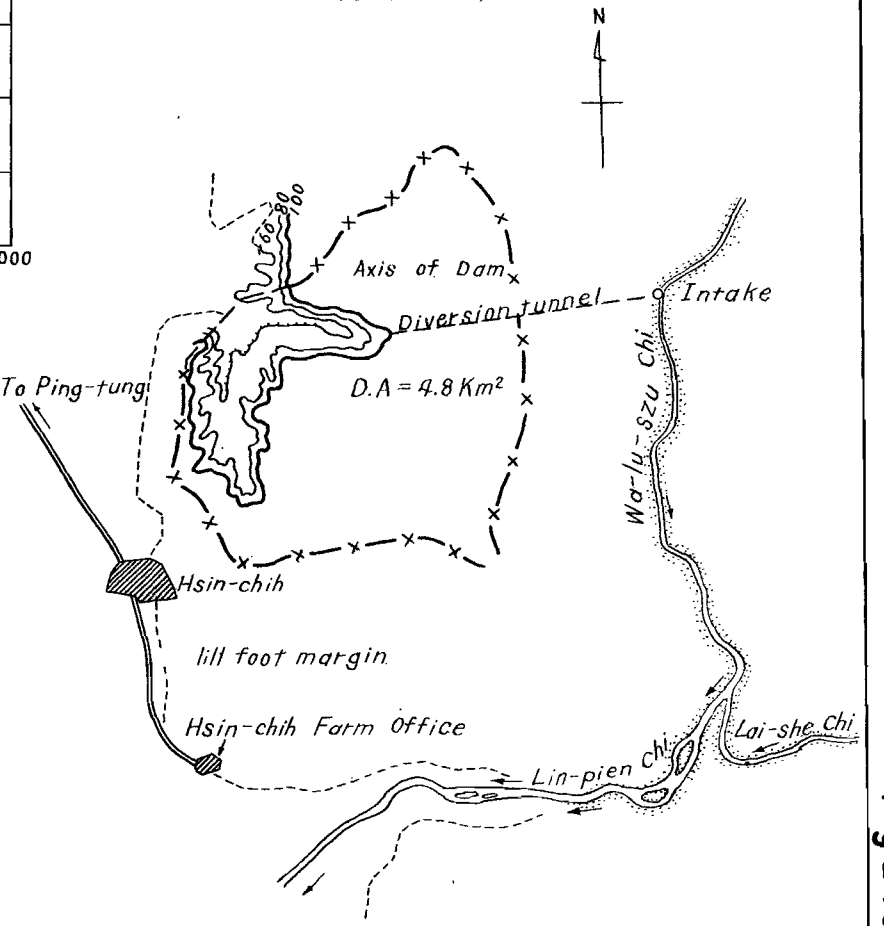
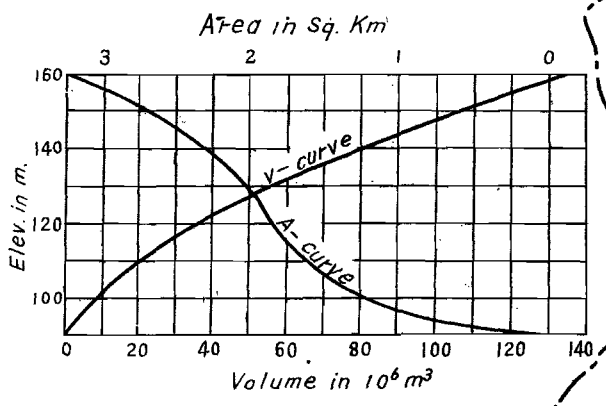


Fig 246

LAI-SHE RESERVOIR

V–A CURVE



Elev.(m)	A (m^2)	V (m^3)
90	0	0
100	1,260,000	6,300,000
120	1,840,000	37,300,000
140	2,280,000	78,500,000
160	3,200,000	133,300,000

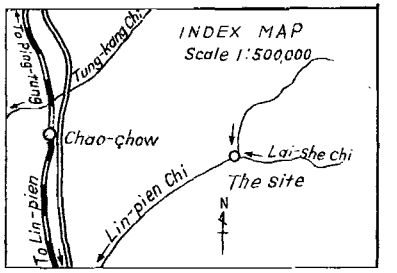
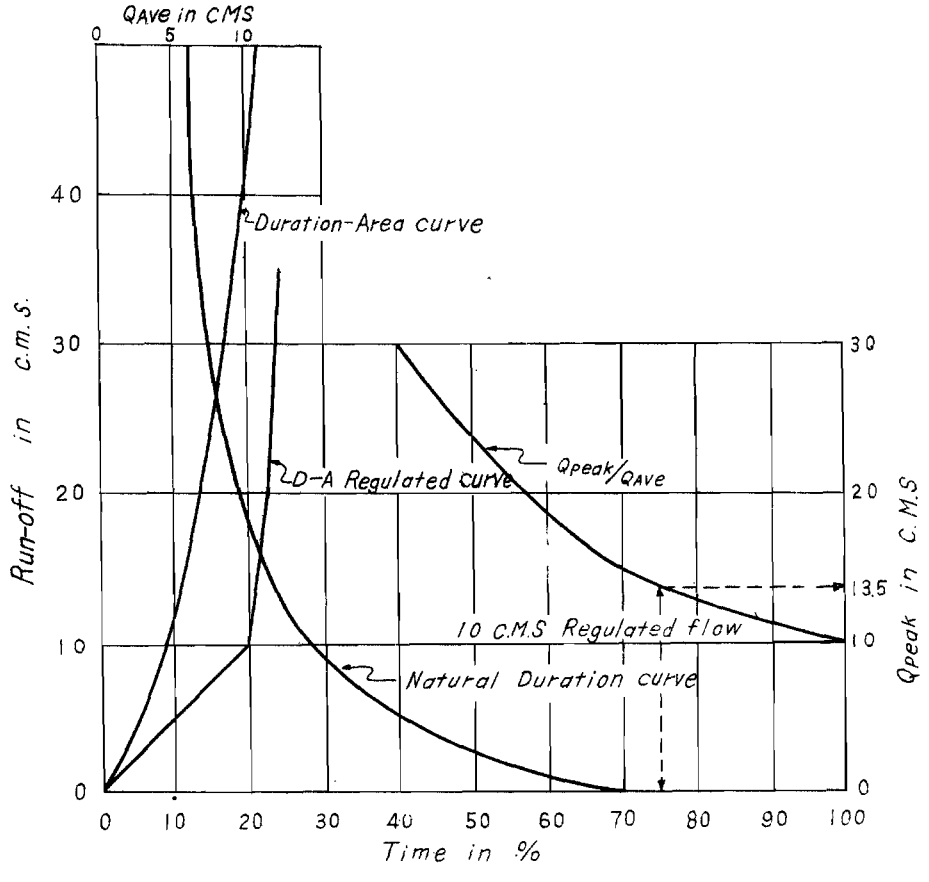
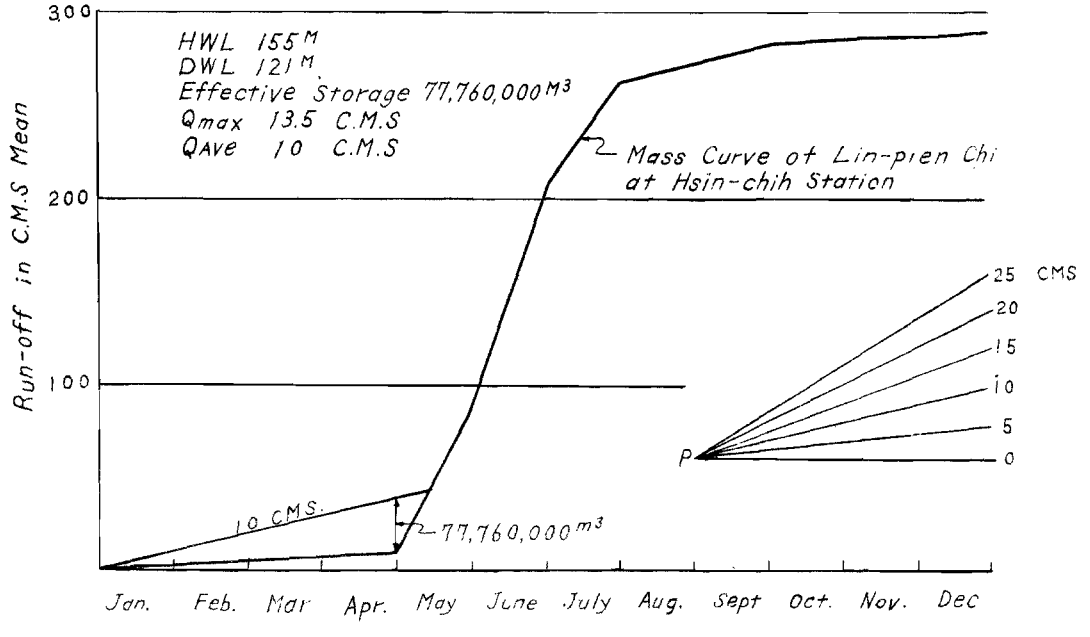
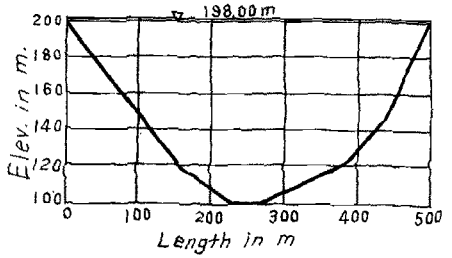


Fig 247


QAVE in CMS
0
5
10
40
30
20
10
0
Run-off in c.m.s.
Duration-Area curve
D-A Regulated curve
Qpeak/QAVE
10 C.M.S Regulated flow
Natural Duration curve
30
20
13.5
10
0
Qpeak in C.M.S
0 10 20 30 40 50 60 70 80 90 100
Time in %

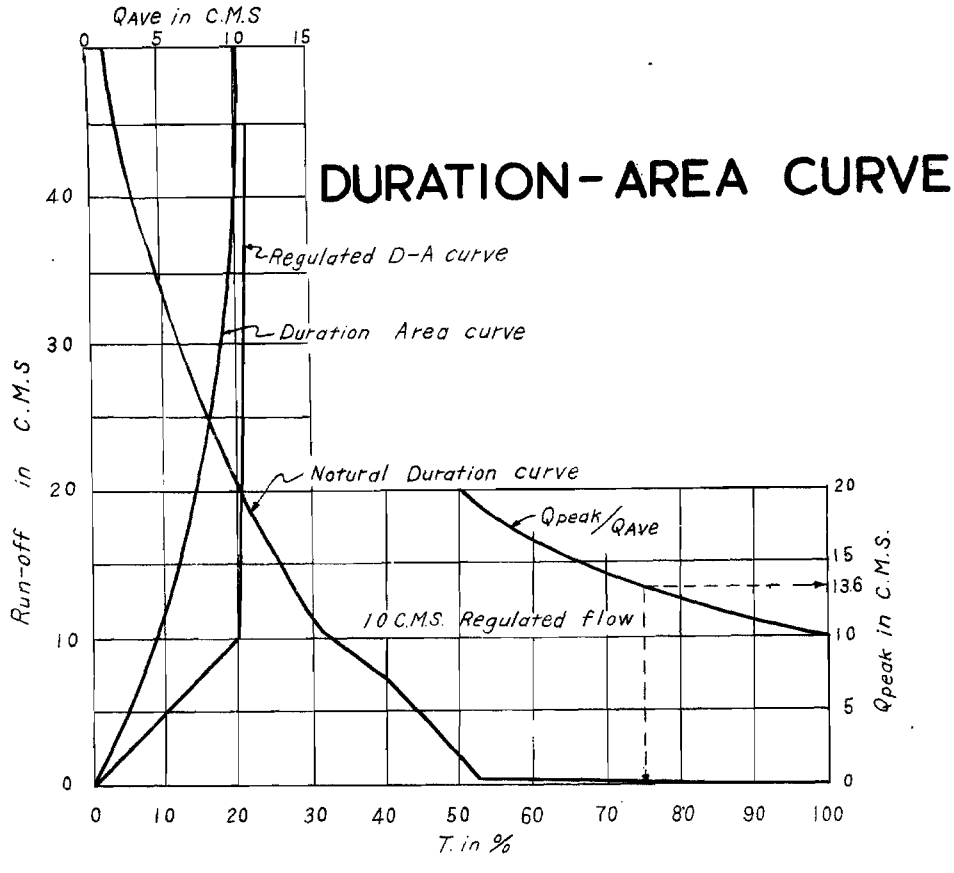

300
200
100
Run-off in C.M.S Mean
HWL 155 M
DWL 121 M
Effective Storage 77,760,000 M3
Qmax 13.5 C.M.S
QAVE 10 C.M.S
Mass Curve of Lin-pien Chi at Hsin-chih Station
25 CMS
20
15
10
5
0
P
10 C.M.S.
77,760,000 m3
Jan. Feb. Mar Apr. May June July Aug. Sept Oct. Nov. Dec

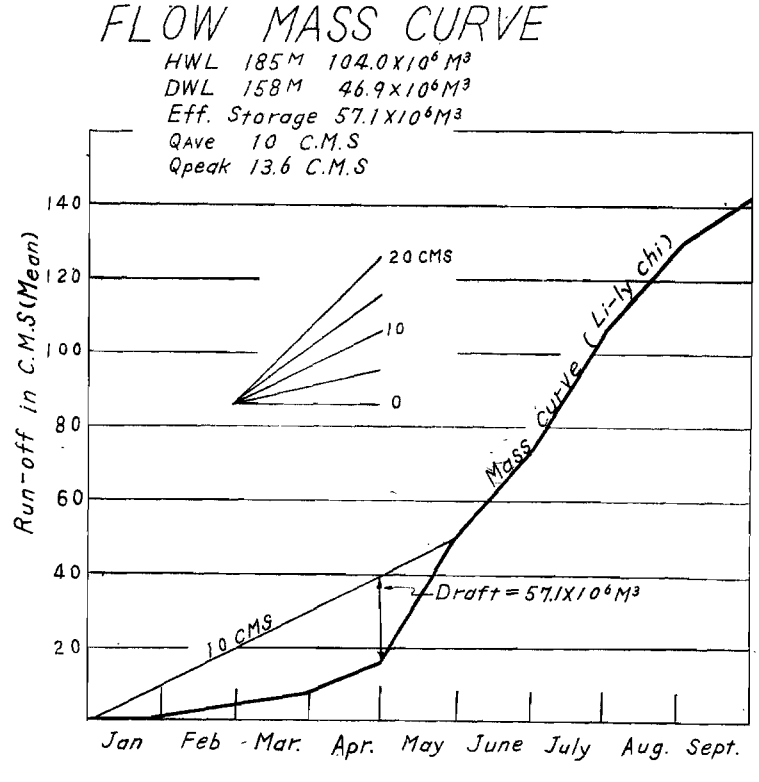
LI-LY RESERVOIR



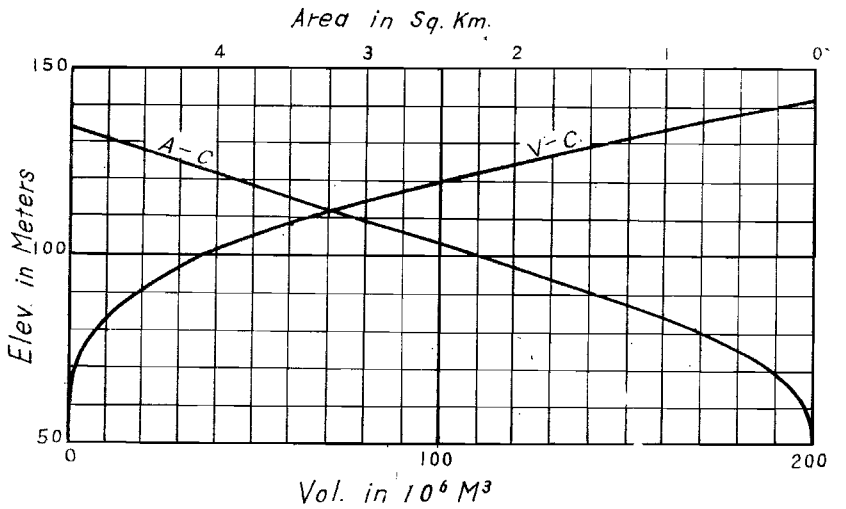
Elev.(m)	A (Km²)	V. (10⁶ m³)
100	0.03	0
120	0.48	5.10
140	1.07	20.60
160	1.76	48.90
180	2.46	91.10
200	3.34	149.05

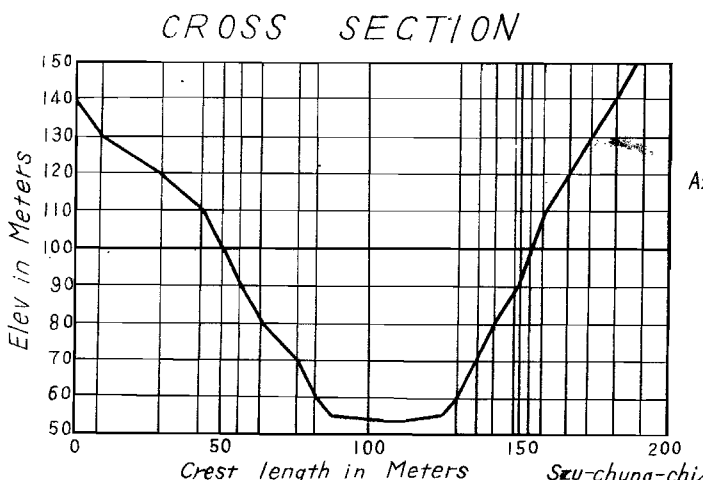
Fig 249


QAve in C.M.S
0
5
10
15
DURATION-AREA CURVE
Regulated D-A curve
Duration Area curve
Natural Duration curve
Qpeak/QAve
10 C.M.S. Regulated flow
13.6
Run-off in C.M.S
Qpeak in C.M.S.
T. in %
0
10
20
30
40
50
60
70
80
90
100


FLOW MASS CURVE
HWL 185M 104.0X10⁶M³
DWL 158M 46.9X10⁶M³
Eff. Storage 57.1X10⁶M³
QAve 10 C.M.S
Qpeak 13.6 C.M.S
20 CMS
10
0
Mass Curve (Li-ly chi)
Draft = 57.1X10⁶M³
10 CMS
Run-off in C.M.S(Mean)
Jan
Feb
Mar.
Apr.
May
June
July
Aug.
Sept.

SZU-CHUNG CHI RESERVOIR





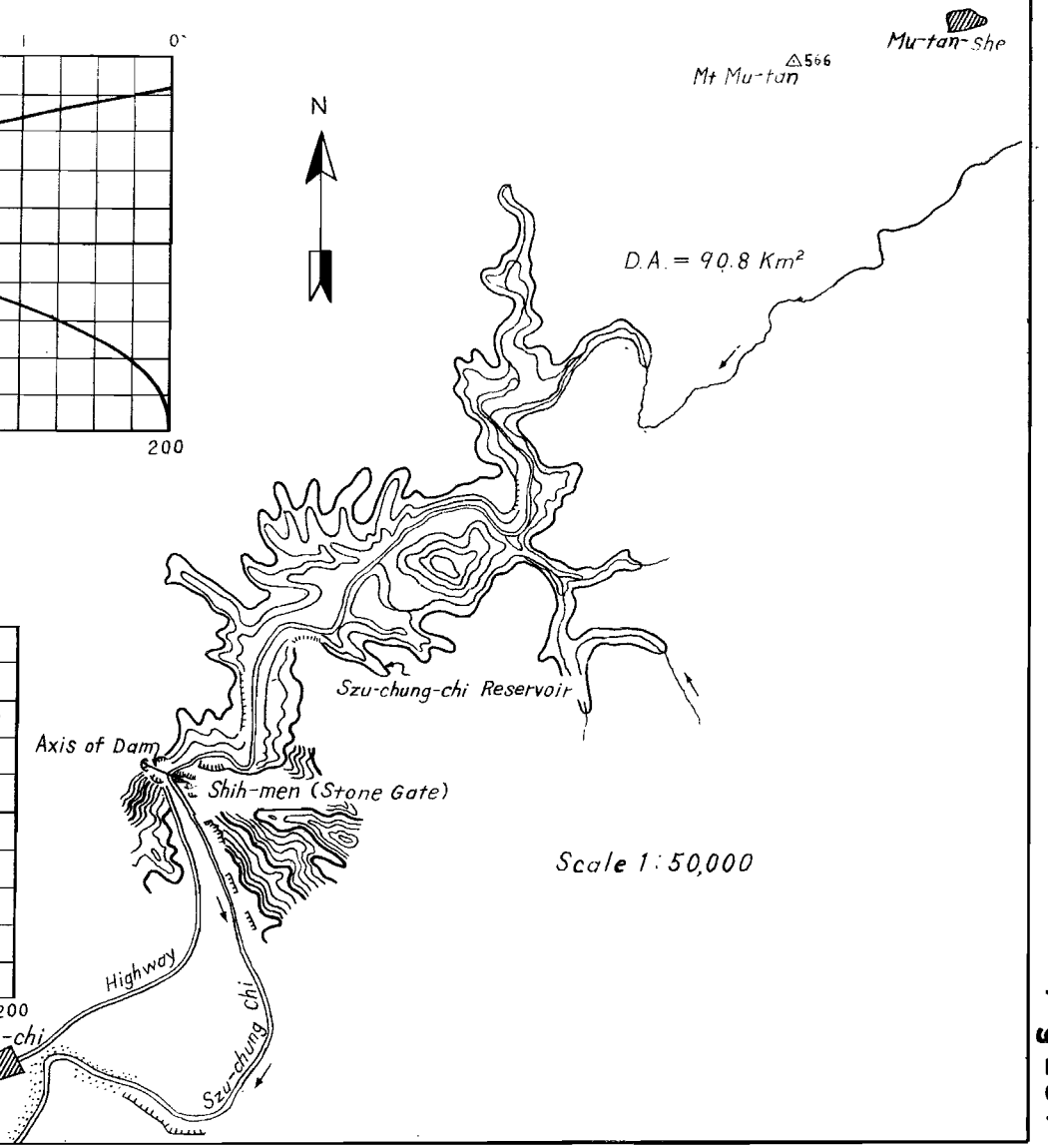
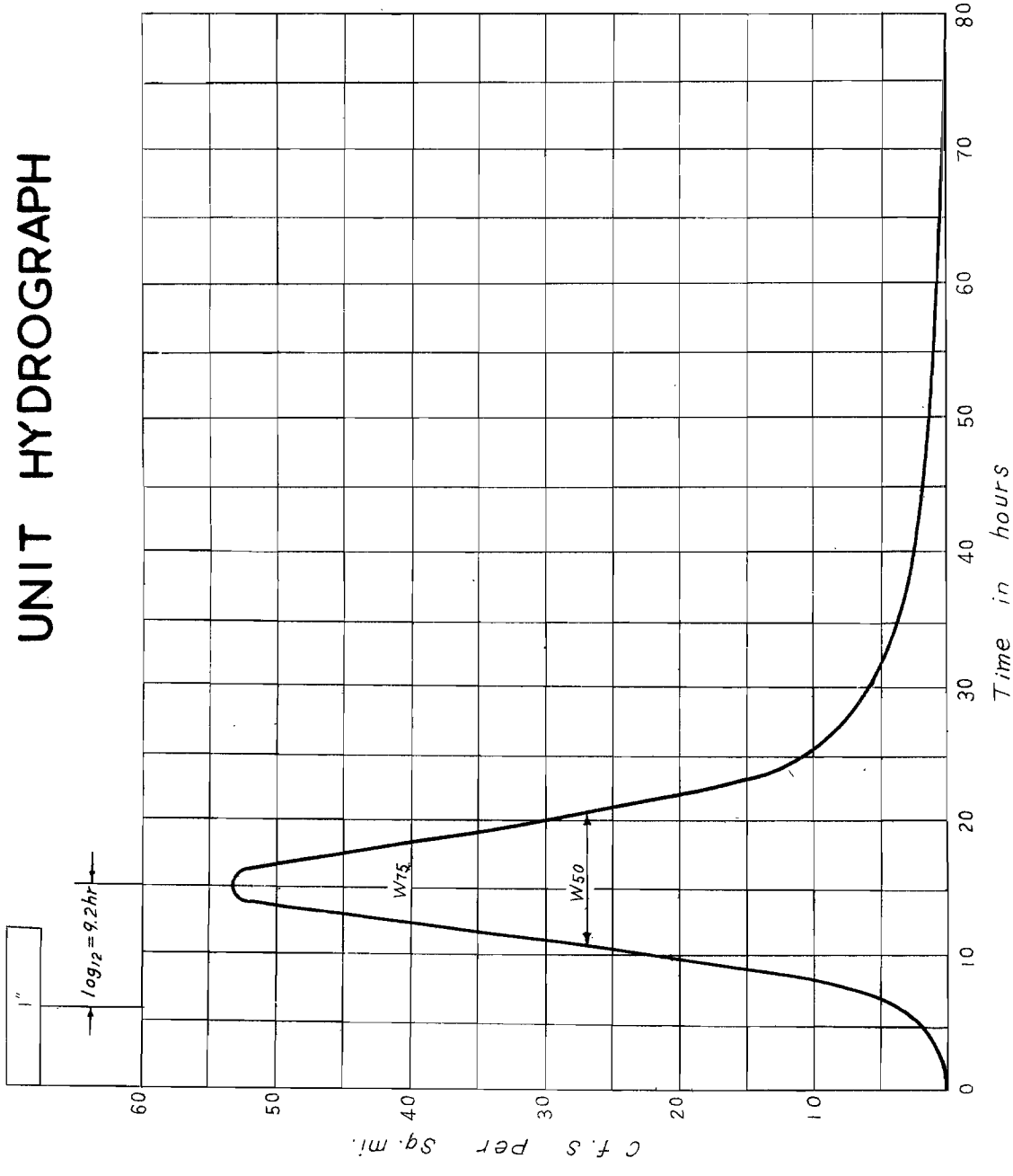


Fig 251

Fig 252


UNIT HYDROGRAPH
1"
$log_{12} = 9.2hr$
W75
W50
0
10
20
30
40
50
60
70
80
Time in hours
10
20
30
40
50
60
C f s Per Sq. mi.

SZU-CHUNG-CHI RESERVOIR

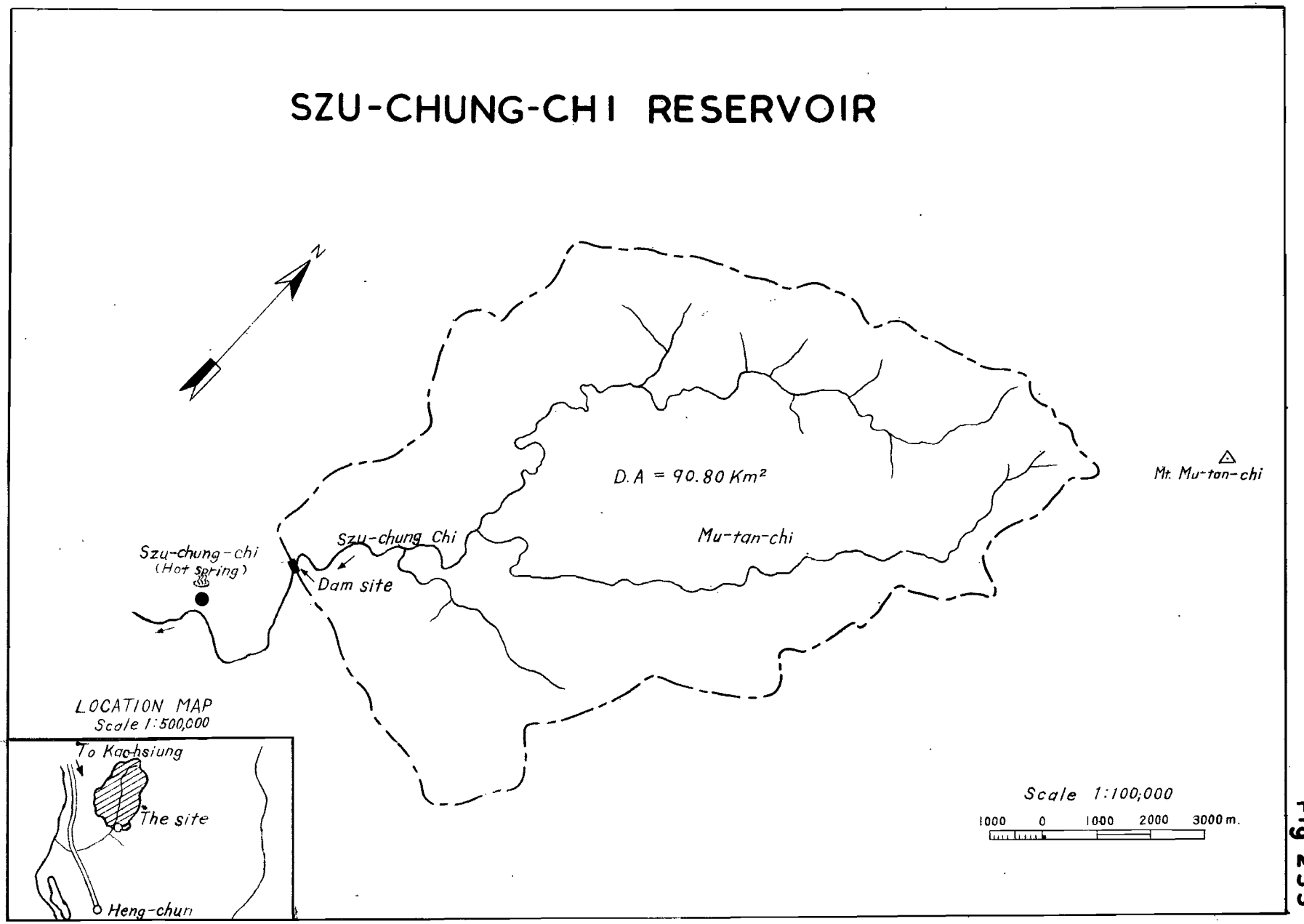
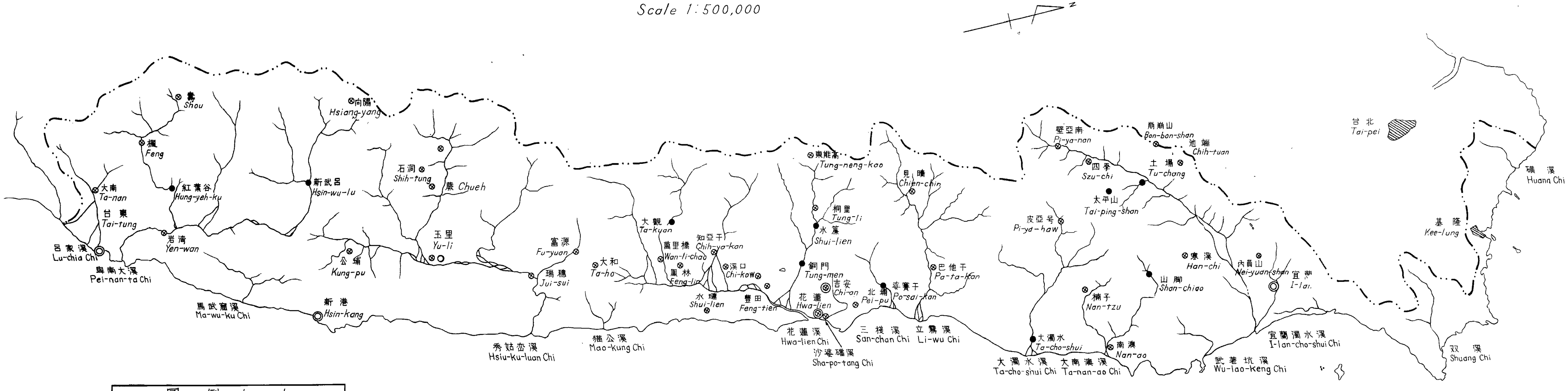


Fig 253

MAP OF METEOROLOGICAL & CLIMATOLOGICAL STATIONS (EAST TAIWAN)

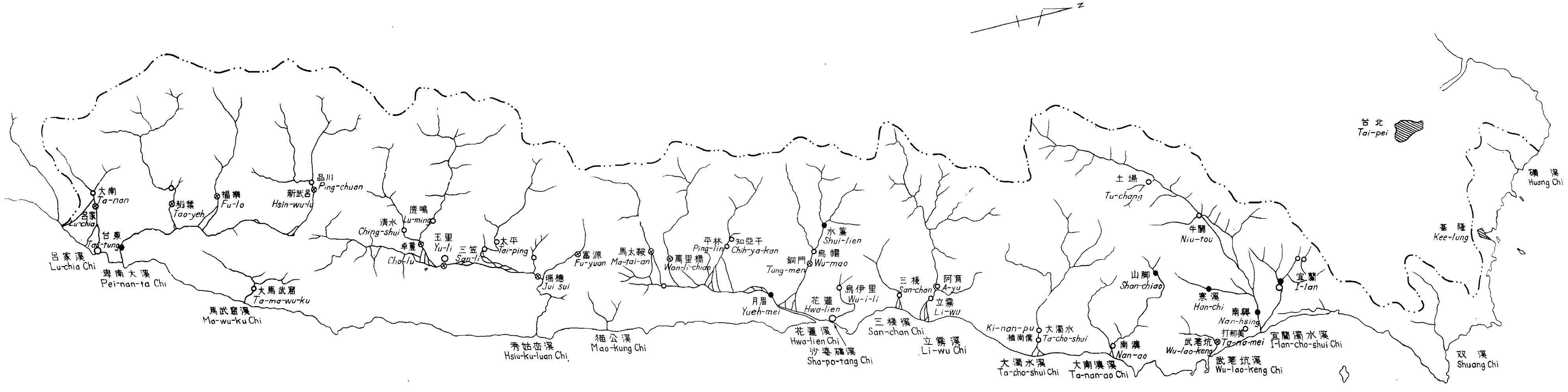
Scale 1:500,000



圖例 Legend		
	河流	River
◎	氣象站	Meteorological Station
●	雨量站	Rainfall Station
⊗	中止雨量站	Abandoned Station

LOCATION MAP OF HYDROLOGICAL STATIONS (EAST TAIWAN)

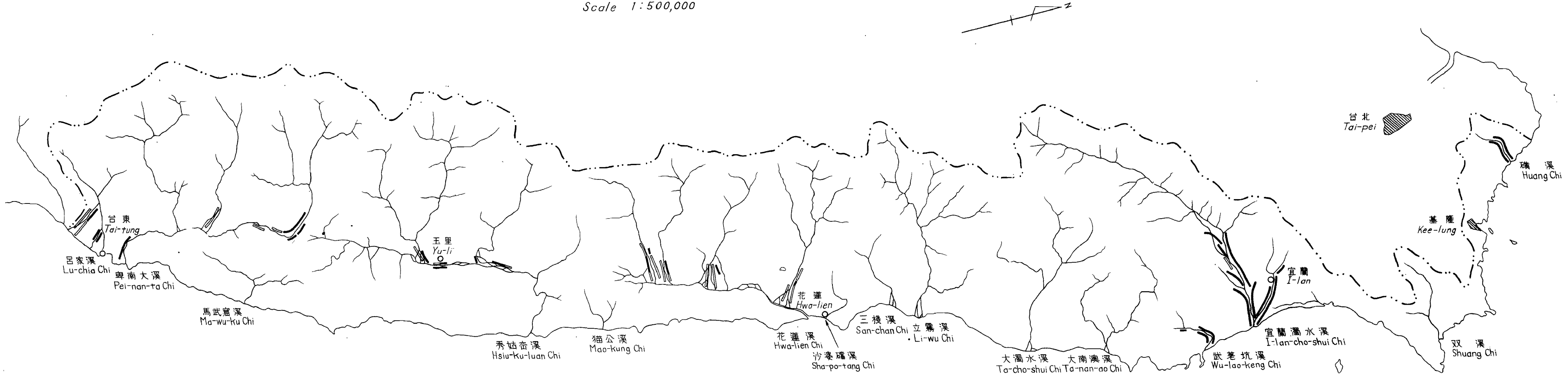
Scale 1:500,000



圖例 Legend		
●	水文站	Hydrological Station
⊗	水位站	Gaging Station
○	中止水文站	Abandoned Station

MAP OF RIVER WORKS (EAST TAIWAN)

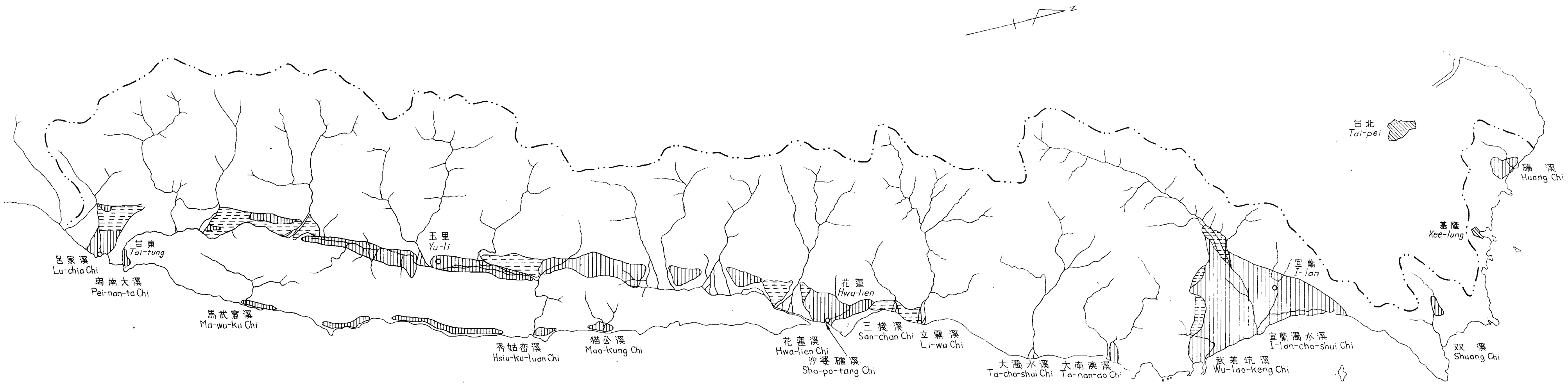
Scale 1:500,000



圖例	Legend
河流	River
已成堤防	Existing Dike
未成堤防	Proposed Dike
鄉鎮	Town

MAP OF IRRIGATION AREAS (EAST TAIWAN)

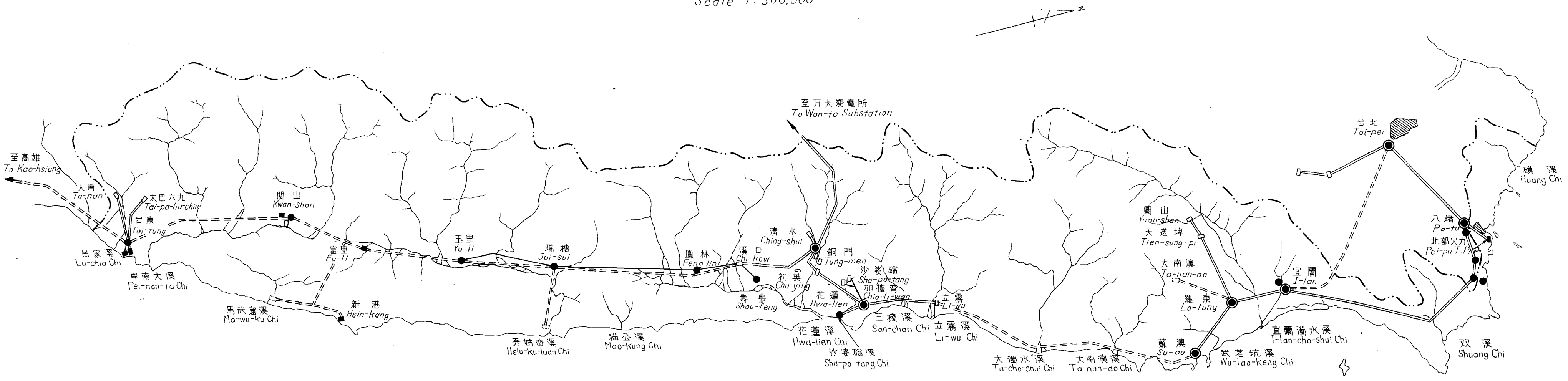
Scale 1:500,000



圖例	Legend
河流	River
灌溉區域	Irrigation Area
可擴充區域	Irrigable Area
鄉鎮	Town

MAP OF ELECTRIC POWER SYSTEM (EAST TAIWAN)

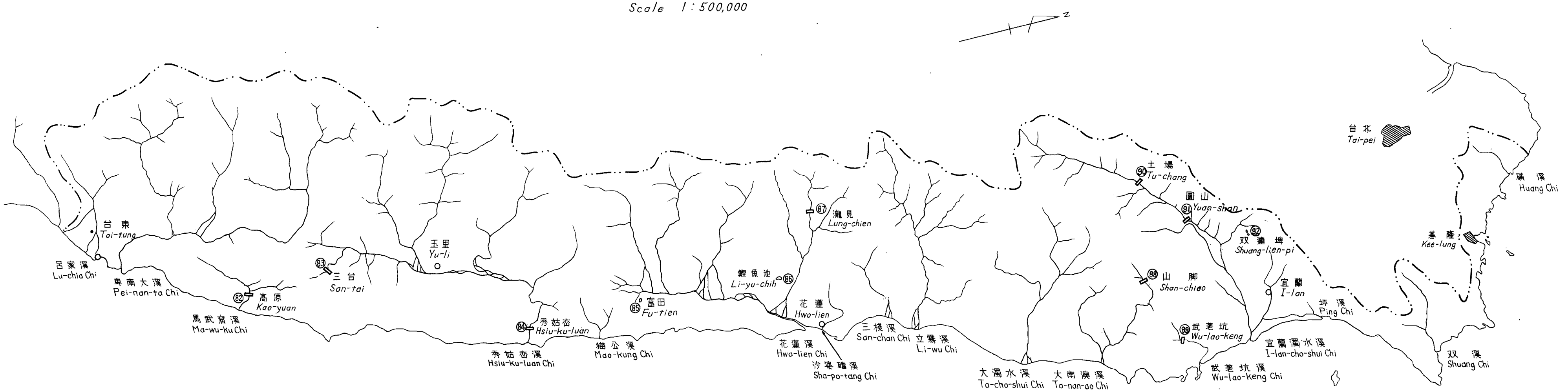
Scale 1:500,000



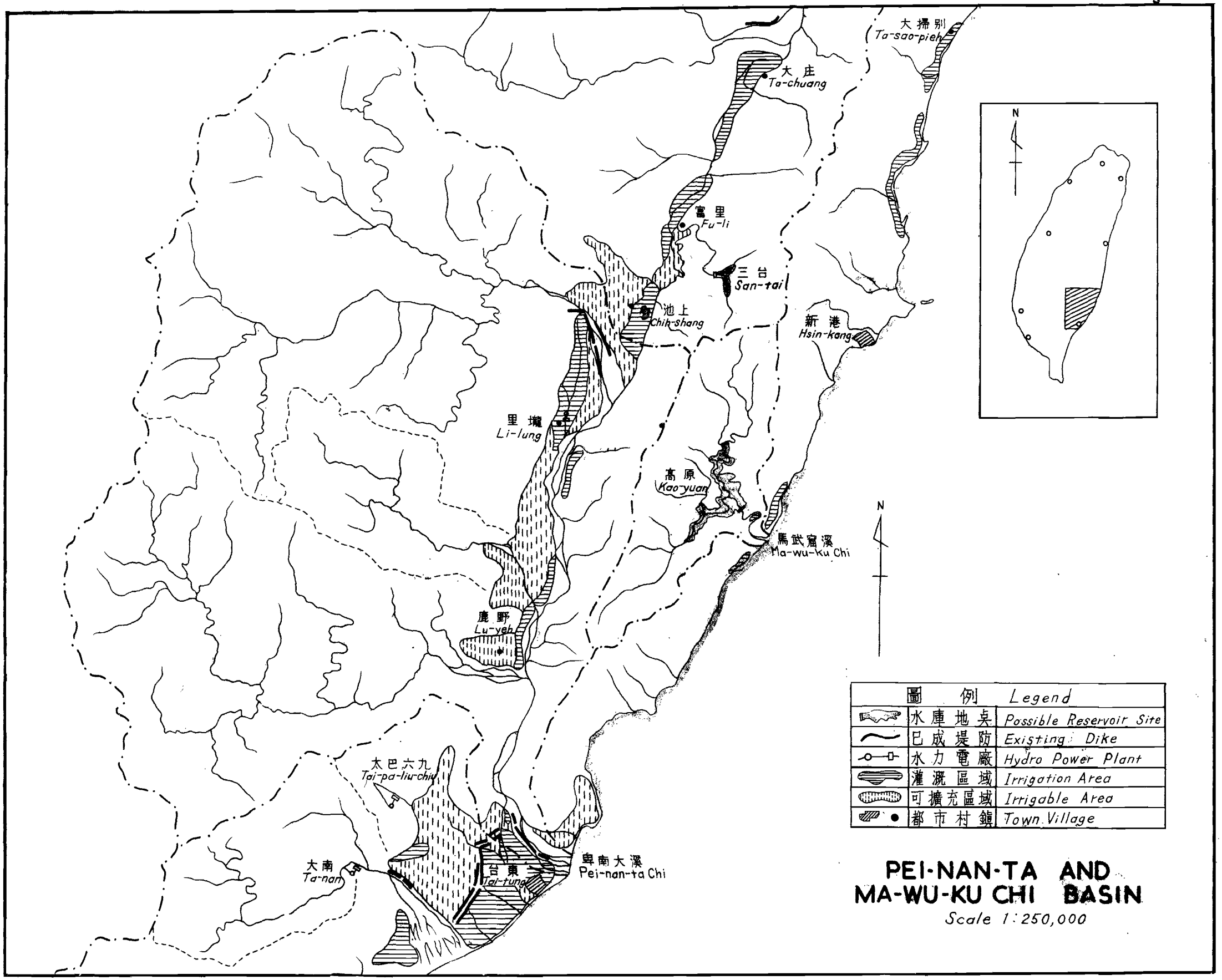
圖例	Legend
■	火力電廠 Thermal Power Plant
□	水力電廠 Hydro Power Plant
◉	一次變電所 Primary Substation
●	二次變電所 Secondary Substation
═══	一次輸電線 Primary Transmission Line
———	二次輸電線 Secondary Transmission Line
═══	拟建輸電線 Proposed Transmission Line

MAP OF POSSIBLE RESERVOIR SITES (EAST TAIWAN)

Scale 1 : 500,000

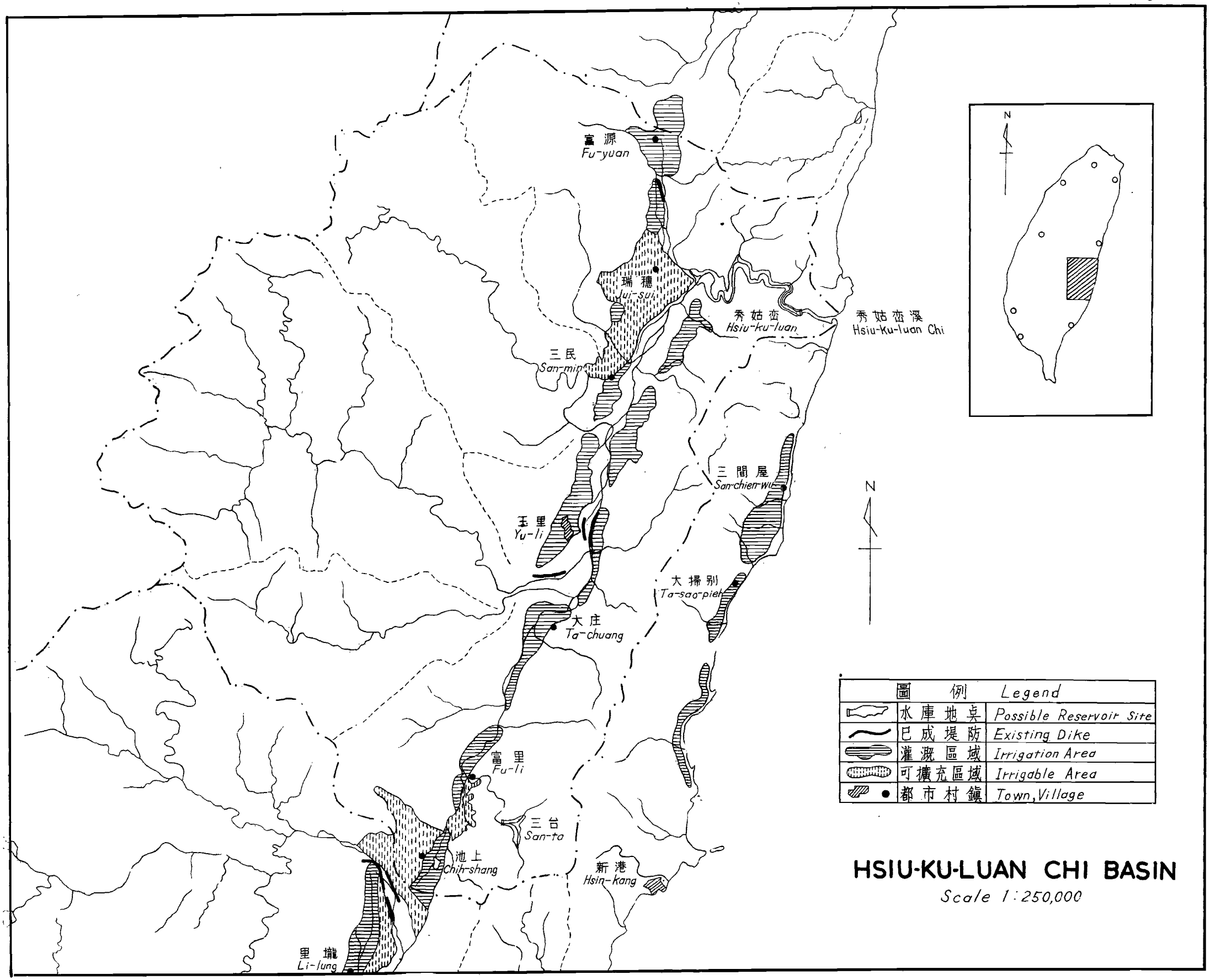


圖例 Legend		
	河流	River
○	鄉鎮	Town
▭	壩址	Possible damsite



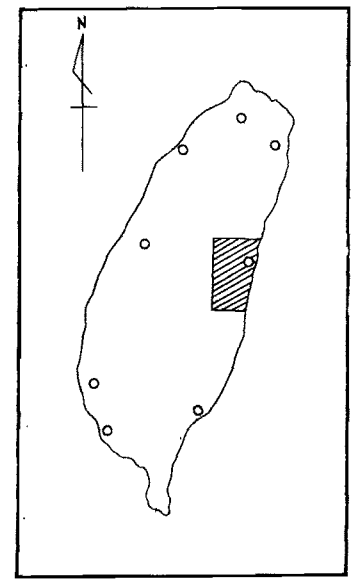
PEI-NAN-TA AND MA-WU-KU CHI BASIN

Scale 1:250,000



HSIU-KU-LUAN CHI BASIN

Scale 1 : 250,000



三棧 San-chan
北埔 Pei-pu
沙婆礁 Sha-po-tang
瀧見 Lung-chien
銅門 Tung-men
花蓮 Hwa-lien
初英 Chu-ying
花蓮溪 Hwa-lien Chi
清水 Ching-shui
鯉魚池 Liyu-chih
志學 Chih-hsioh
溪口 Chi-kow
鳳林 Feng-lin
馬太鞍 Ma-tai-an
富田 Fu-tien
富源 Fu-yuan

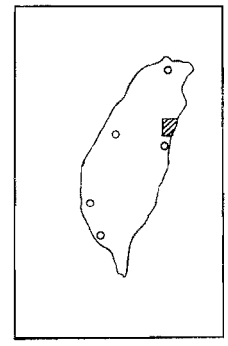
圖 例 Legend		
	水庫地点	Possible Reservoir Site
	已成堤防	Existing Dike
	水力電廠	Hydro Power Plant
	灌溉區域	Irrigation Area
	可擴充區域	Irrigable Area
	都市村鎮	Town Village

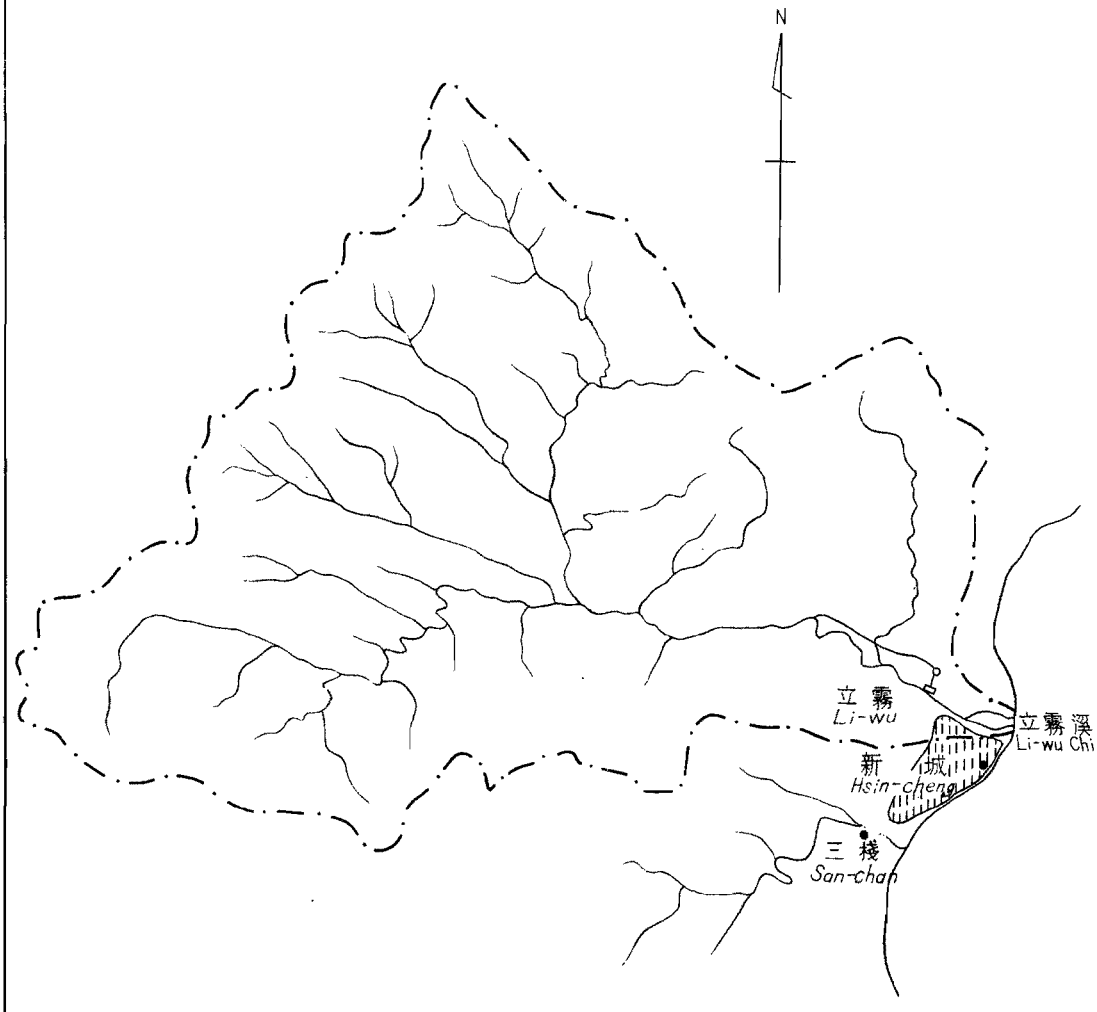
HWA-LIEN CHI BASIN

Scale 1:250,000

LI-WU CHI BASIN

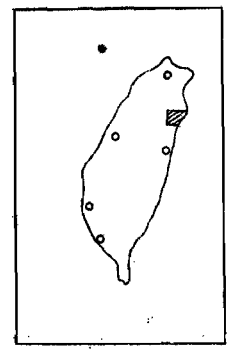
Scale 1 : 250,000

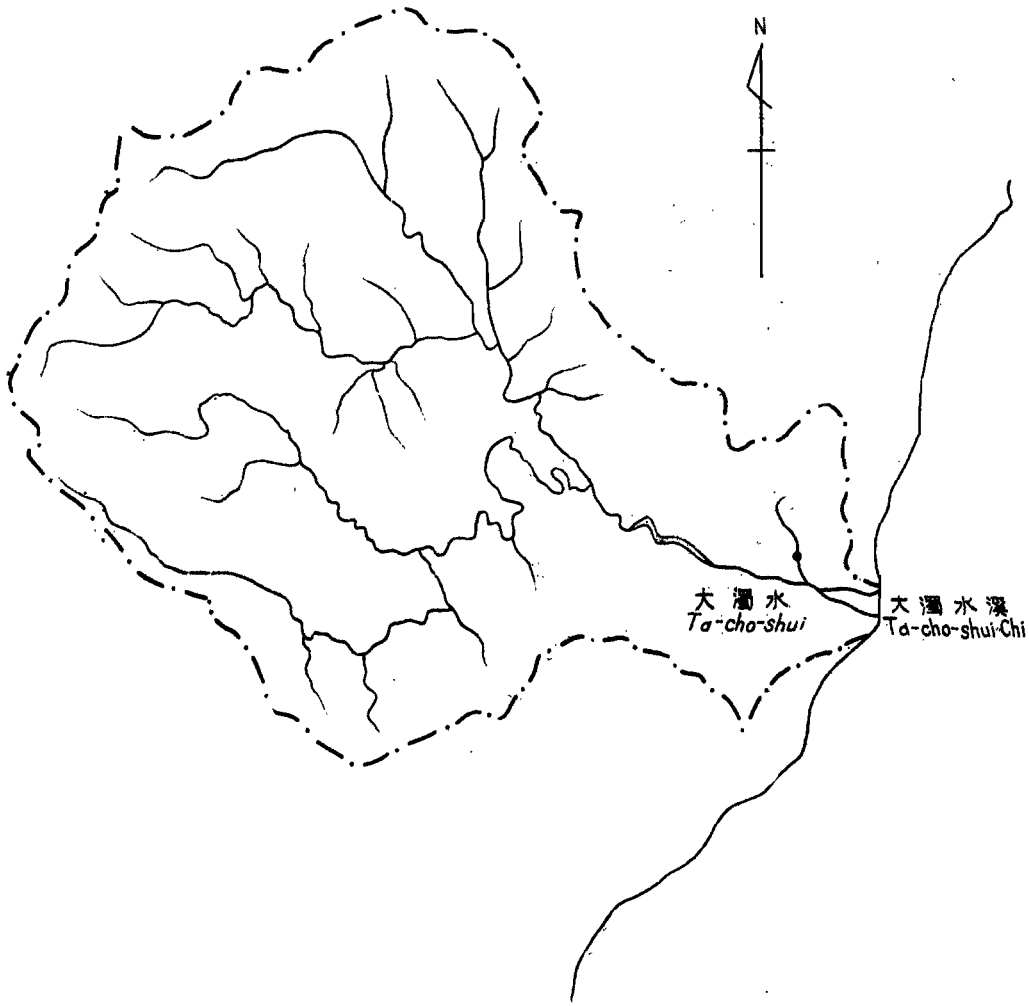


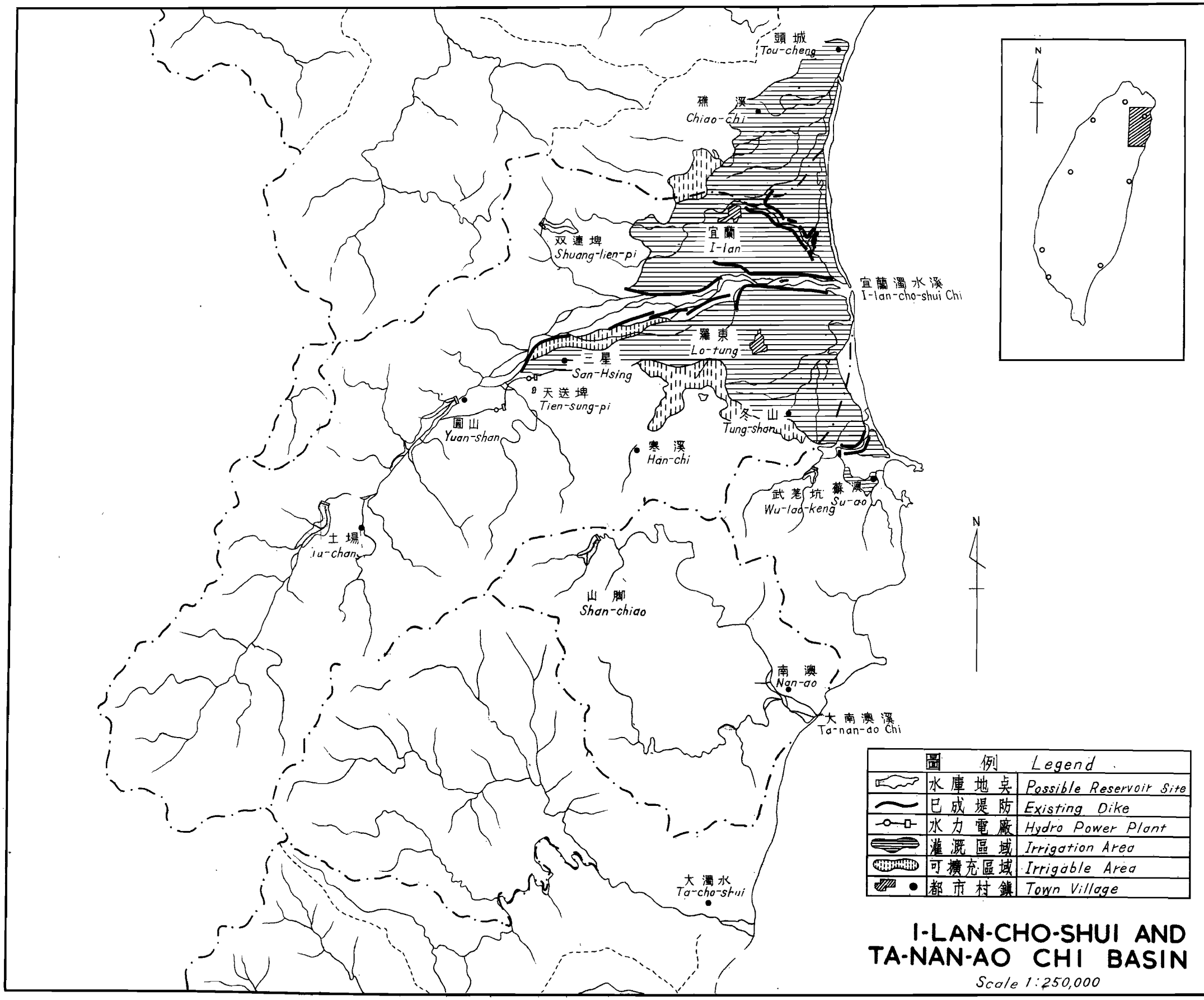


TA-CHO-SHUI CHI BASIN

Scale 1:250,000





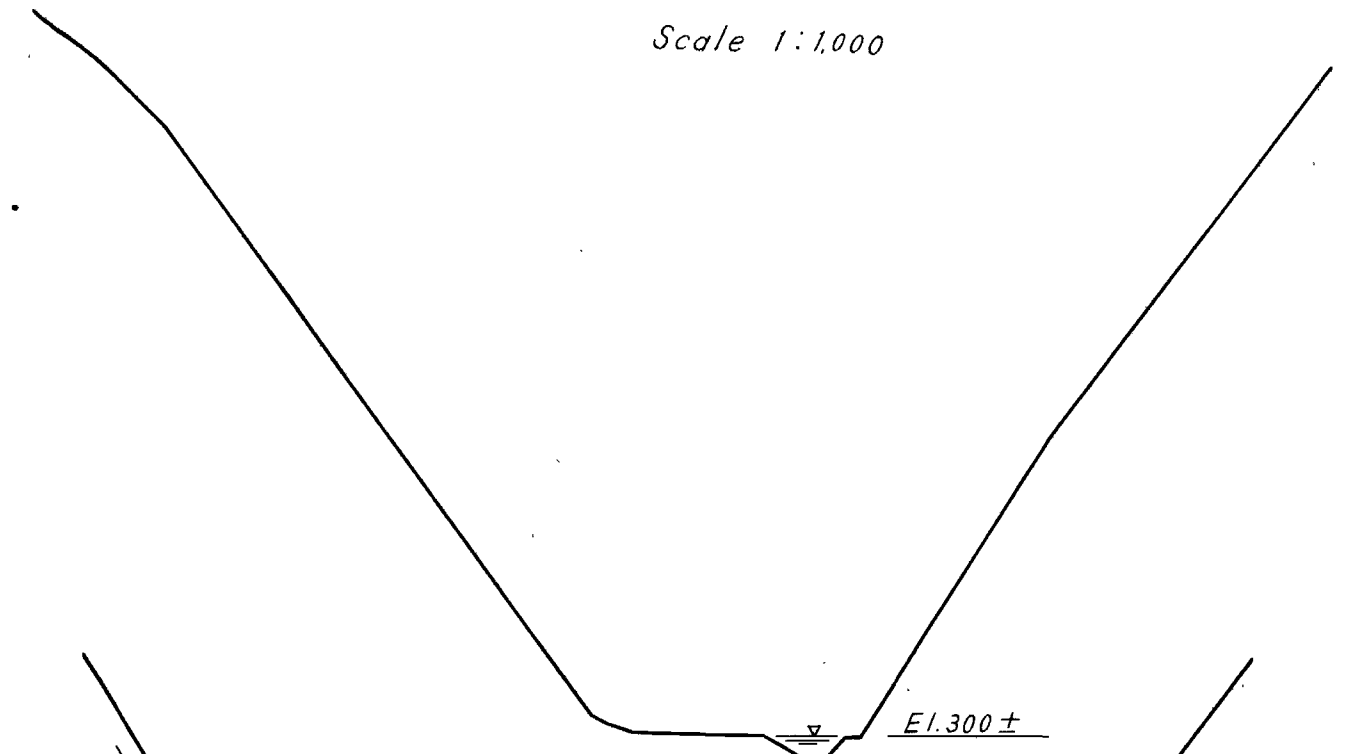


I-LAN-CHO-SHUI AND TA-NAN-AO CHI BASIN

Scale 1:250,000

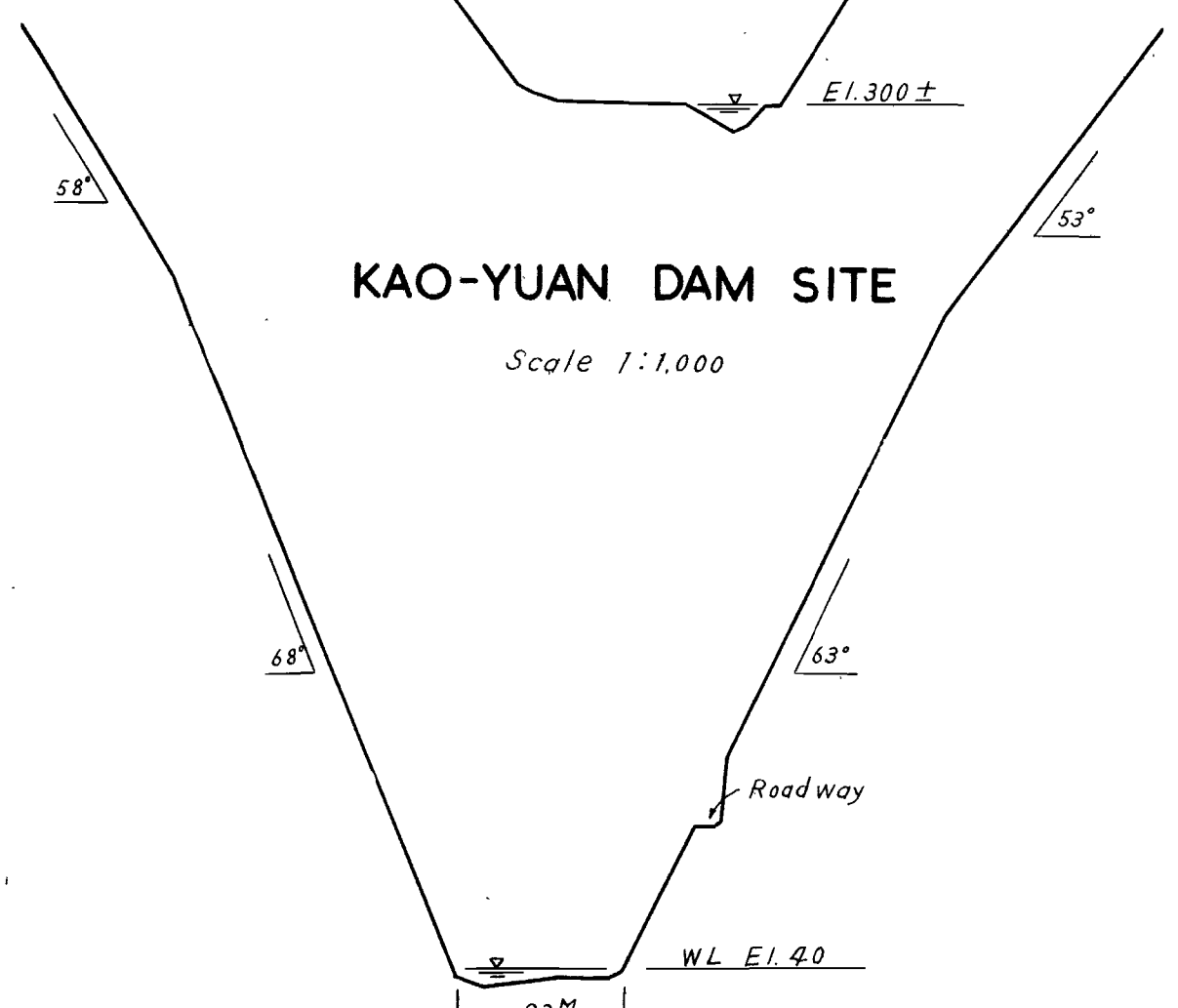
SAN-TAI DAM SITE

Scale 1:1,000



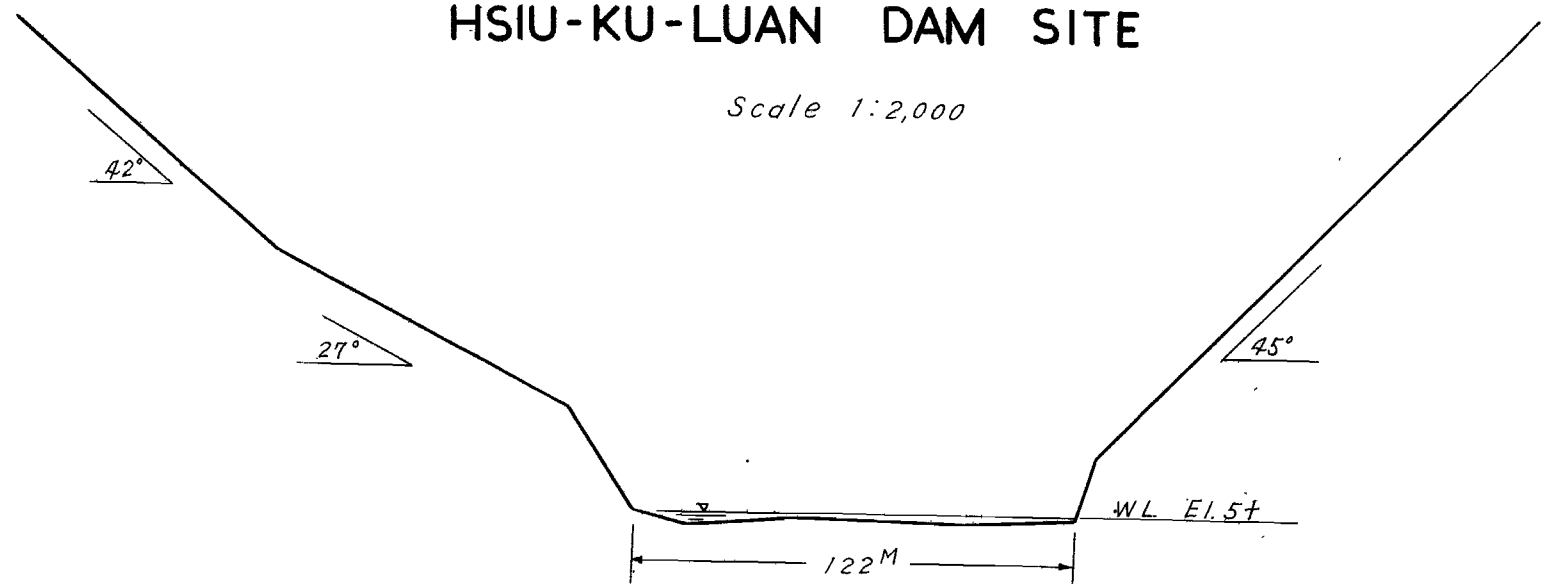
KAO-YUAN DAM SITE

Scale 1:1,000



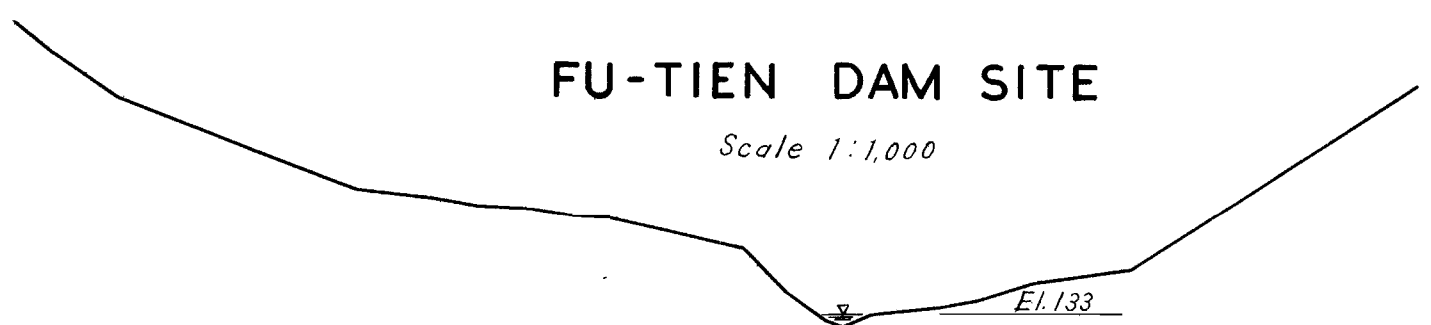
HSIU-KU-LUAN DAM SITE

Scale 1:2,000



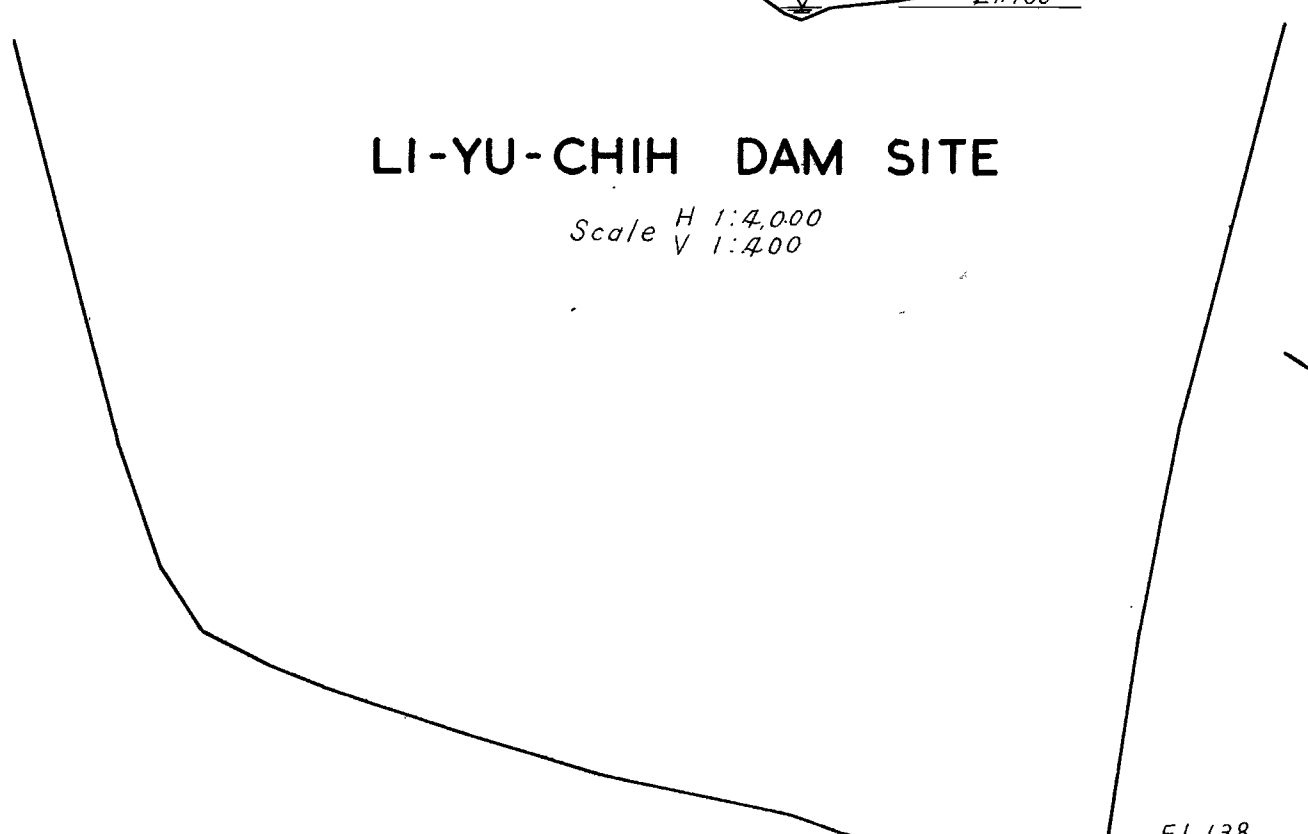
FU-TIEN DAM SITE

Scale 1:1,000



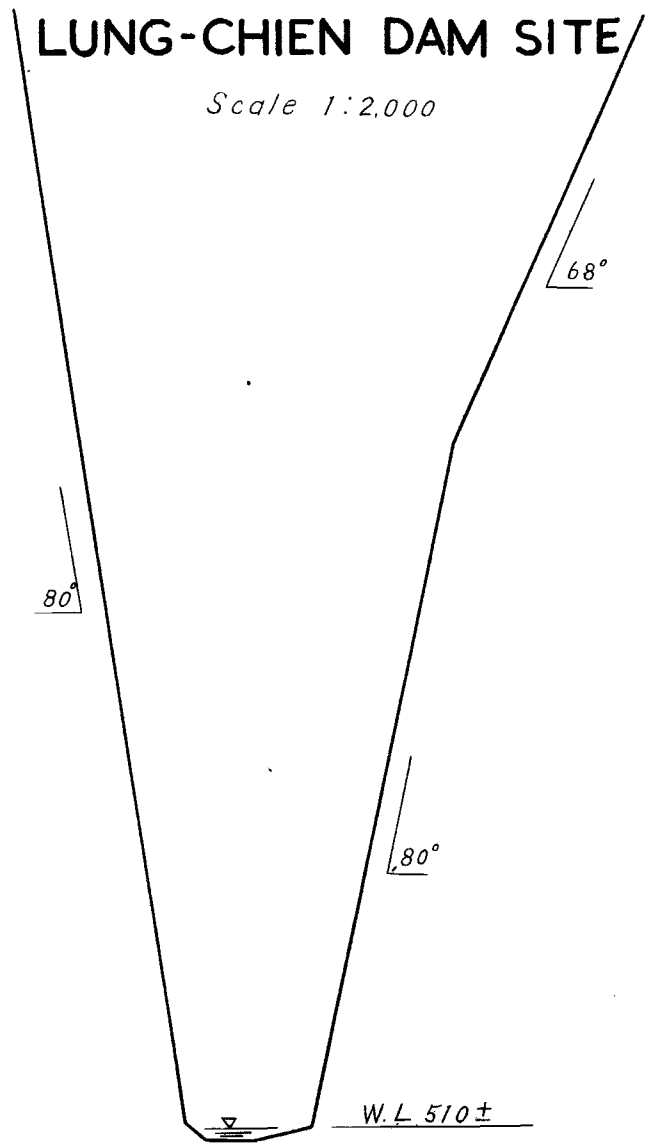
LI-YU-CHIH DAM SITE

Scale H 1:4,000
V 1:400



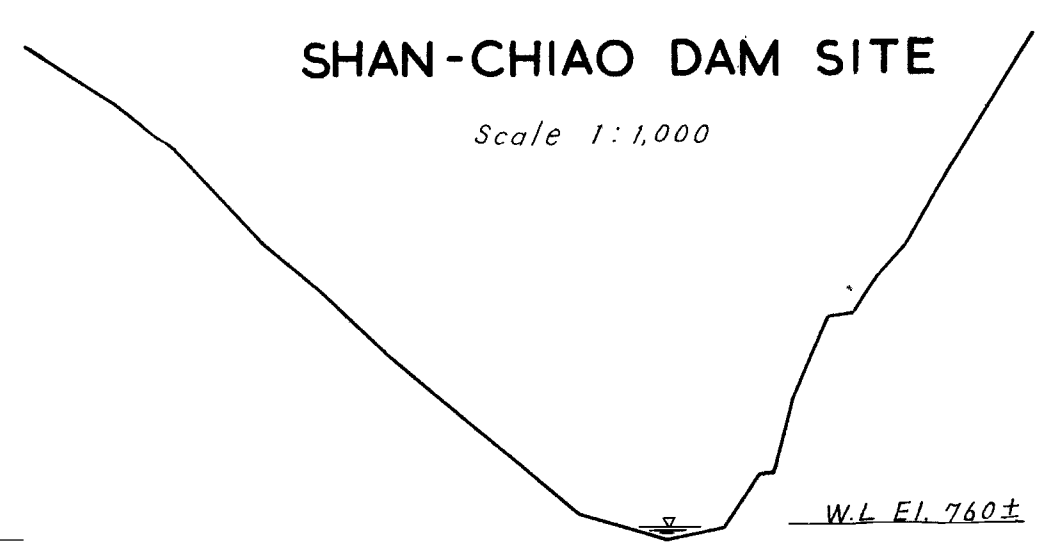
LUNG-CHIEN DAM SITE

Scale 1:2,000



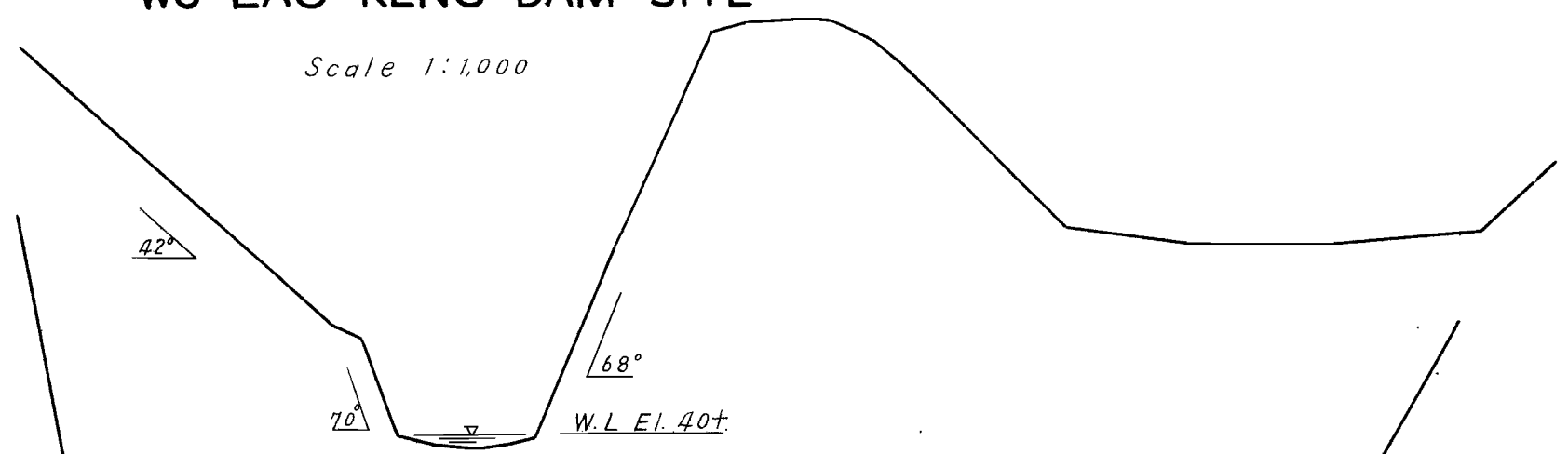
SHAN-CHIAO DAM SITE

Scale 1:1,000



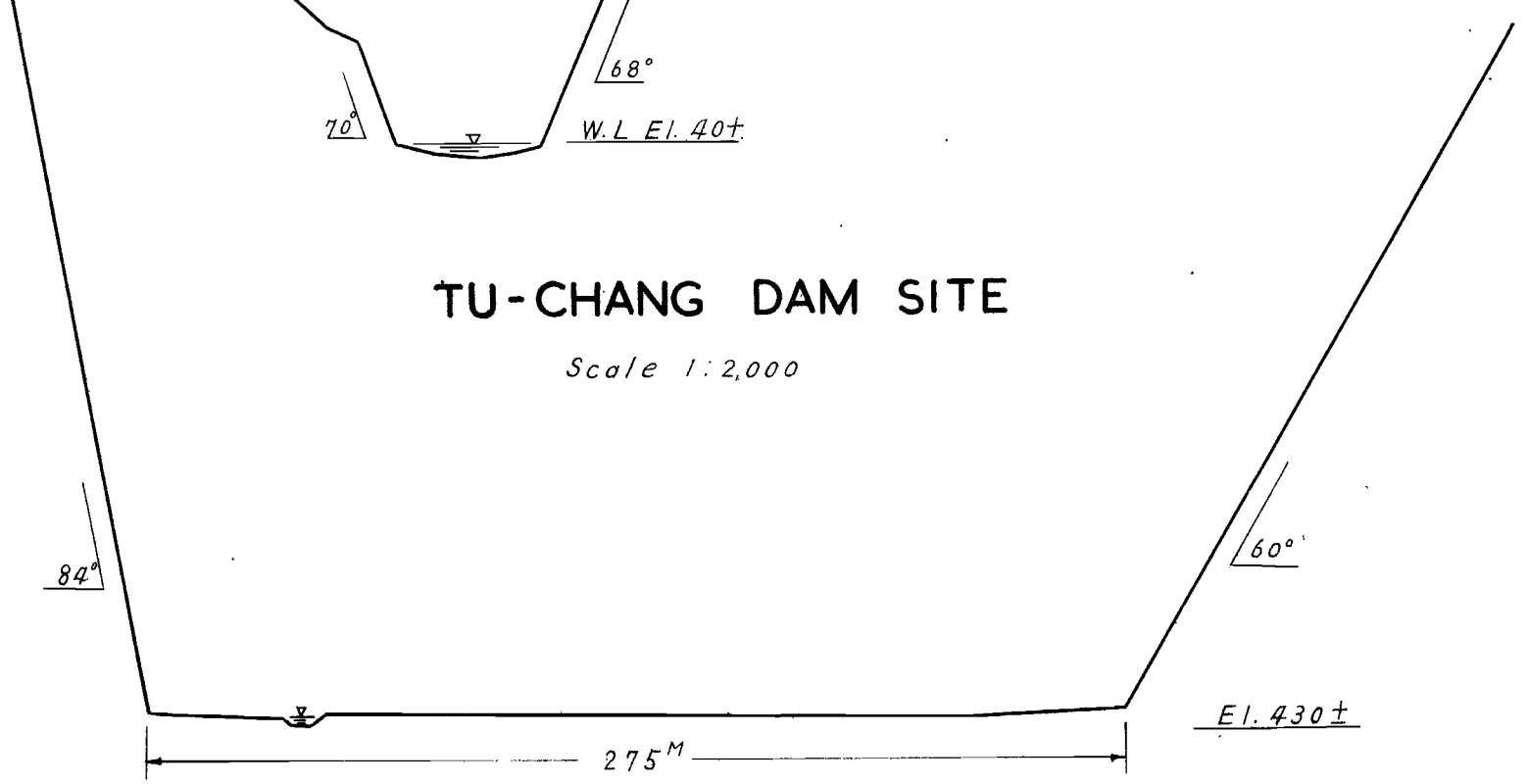
WU-LAO-KENG DAM SITE

Scale 1:1,000



TU-CHANG DAM SITE

Scale 1:2,000



YUAN-SHAN DAM SITE

Scale 1:4,000