

APPENDIX III

TABLE III-1 CAPABILITY OF EXISTING, UNDER CONSTRUCTION AND FUTURE POWER PLANTS

Plants	Power (MW)		Energy (Gwh)	
	Installed	Dependable	Average	Firm
<u>EXISTING POWER PLANTS</u>				
<u>HYDRO POWER PLANTS</u>				
Bhumibol Dam Units 1-7	535.0	441.1	1,414.1	891.4
Sirikit Dam Units 1-3	375.0	280.5	1,005.3	644.9
Ubolratana Dam Units 1-3	25.2	20.3	56.1	35.0
Sirindhorn Dam Units 1-2	24.0	22.7	59.3	35.0
Chulabhorn Dam Units 1-2	40.0	39.5	76.4	56.2
Kang Krachan Dam Unit 1	19.0	13.5	77.2	48.4
Nam Pung Units 1-2	6.0	5.7	15.1	7.0
Srinagarind Dam Units 1-3	360.0	360.0	1,162.0	861.0
Bang Lang (Pattani) Units 1-3	72.0	53.5	208.8	116.8
Tha Thung Na Units 1-2	38.0	38.0	166.6	127.3
Huai Kum	1.3	1.3	3.0	-
Ban Yang	0.1	0.1	0.3	-
Ban Santi	1.3	1.3	6.1	-
<b>Total</b>	<b>1,496.9</b>	<b>1,277.5</b>	<b>4,250.3</b>	<b>2,823.0</b>
<u>THERMAL POWER PLANTS</u>				
North Bangkok Units 1-3	237.5	225.6	1,660.0	1,660.0
South Bangkok Units 1-5	1,300.0	1,235.0	8,713.0	8,713.0
Krabi Power Plant Units 1-3	60.0	54.0	300.0	300.0
Surat Thani Power Plant Unit 1	30.0	28.5	210.0	210.0
Mae Moh Unit 1	75.0	71.3	492.3	492.3
Mae Moh Unit 2	75.0	71.3	492.3	492.3
Mae Moh Unit 3	75.0	71.3	492.3	492.3
Khanom Barge - Mounted	75.0	71.3	525.0	525.0
Bang Pakong Thermal Unit 1	550.0	522.5	3,372.0	3,372.0
<b>Total</b>	<b>2,477.5</b>	<b>2,350.8</b>	<b>16,256.9</b>	<b>16,256.9</b>
<u>COMBINED CYCLE POWER PLANTS</u>				
Bang Pakong Combined Cycle Blocks I & II	720.0	684.0	3,780.0	3,780.0
<b>Total</b>	<b>720.0</b>	<b>684.0</b>	<b>3,780.0</b>	<b>3,780.0</b>
<u>GAS TURBINE POWER PLANTS</u>				
Nakhon Ratchasima Unit 1	15.0	13.5	13.0	13.0
Udon Thani Unit 1	15.0	13.5	13.0	13.0
Hat Yai Units 1-3	45.0	40.5	39.0	39.0
Surat Thani Units 3-5	45.0	40.5	39.0	39.0
South Bangkok Gas Turbine Units 1,2,4	75.0	60.0	115.0	115.0
Lan Krabu Units 1, 2, 3	45.0	40.5	295.8	295.8
Lan Krabu Unit 5	25.0	20.0	164.3	164.3
<b>Total</b>	<b>265.0</b>	<b>218.5</b>	<b>679.1</b>	<b>679.1</b>

TABLE III-1 CAPABILITY OF EXISTING, UNDER CONSTRUCTION AND FUTURE POWER PLANTS (CONTINUED)

Plants	Power (MW)		Energy (GWh)	
	Installed	Dependable	Average	Firm
<u>DIESEL POWER PLANTS</u>				
Phuket Units 1-4	10.6	8.5	9.0	9.0
Chiang Mai Units 1-3	3.0	2.4	3.0	3.0
Mae Moh Units 1-8	8.0	6.4	7.0	7.0
Nakhon Si Thammarat Units 1-2	2.0	1.6	2.0	2.0
Bang Lang Units 1-5	5.0	4.0	4.0	4.0
Khao Laem Units 1-5	5.0	4.0	4.0	4.0
Total	33.6	26.9	29.0	29.0
TOTAL EXISTING PLANTS <sup>1/</sup>	4,993.0	4,557.7	24,995.3	23,568.0
<u>POWER PLANTS UNDER CONSTRUCTION</u>				
<u>HYDRO POWER PLANTS</u>				
Khao Laem Units 1-3	300.0	245.0	756.0	523.6
Sirindhorn Unit 3	12.0	10.6	—	—
Srinagarind Unit 4 (Reversible pumped turbine)	180.0	180.0	111.4	130.3
Mae Ngat Units 1-2	9.0	—	29.0	15.5
Chiew Larn Units 1-3	240.0	177.9	553.7	236.9
Total	741.0	613.5	1,450.1	906.3
<u>THERMAL POWER PLANTS</u>				
Mae Moh Unit 4	150.0	142.5	985.0	985.0
Bang Pakong Thermal Unit 2	550.0	522.5	3,372.0	3,372.0
Mae Moh Unit 5	150.0	142.5	985.0	985.0
Mae Moh Unit 6	150.0	142.5	985.0	985.0
Mae Moh Unit 7	150.0	142.5	985.0	985.0
Total	1,150.0	1,092.5	7,312.0	7,312.0
TOTAL UNDER CONSTRUCTION	1,891.0	1,706.0	8,762.1	8,218.3

Note : <sup>1/</sup> Existing Power Plants as of February 1984.

TABLE III-1 CAPABILITY OF EXISTING, UNDER CONSTRUCTION AND FUTURE POWER PLANTS (CONTINUED)

Plants	Power (MW)		Energy (GWh)	
	Installed	Dependable	Average	Firm
<u>FUTURE POWER PLANTS</u>				
<u>HYDRO POWER PLANTS</u>				
Srinagarind Unit 5 (Reversible pumped turbine)	180.0	180.0	-52.8 <sup>2/</sup>	-36.1 <sup>2/</sup>
Kaeng Krung Units 1-2	68.0	65.0	165.0	152.0
Lower Mae Ping Units 1-2 & Bhumibol Unit 8 (Reversible Pumped Turbine)	40.0	17.0	213.0	161.0
Nam Chon Units 1-4	175.0	136.0	13.0 <sup>2/</sup>	13.0 <sup>2/</sup>
Kaeng Sua Ten Unit 1	580.0	580.0	1,182.0	849.7
Sai Buri Unit 1-3	65.0	48.0	143.0	50.0
Miscellaneous Hydro :	100.0	81.0	214.0	157.0
- Mae Kuang	(135.3)	(113.1)	(364.8)	(238.1)
- Nam Chern	4.5	-	15.7	-
- Nam San	32.0	31.4	58.3	19.3
- Upper Pa Sak	58.0	57.7	127.0	102.3
- Chao Phraya	24.0	24.0	69.0	38.5
	16.8	-	94.8	78.0
<b>Total</b>	<b>1,343.3</b>	<b>1,220.1</b>	<b>2,242.0</b>	<b>1,584.7</b>
<u>THERMAL POWER PLANTS</u>				
Krabi (2) Unit 1	75.0	71.3	492.8	492.8
Mae Moh Unit 8	300.0	285.0	1,970.0	1,970.0
Mae Moh Unit 9	300.0	285.0	1,970.0	1,970.0
Mae Moh Unit 10	300.0	285.0	1,970.0	1,970.0
Krabi (2) Unit 2	150.0	142.5	919.8	919.8
Ao Phai Thermal Unit 1	600.0	570.0	3,680.0	3,680.0
Krabi (2) Unit 3	150.0	142.5	919.8	919.8
Ao Phai Thermal Unit 2	600.0	570.0	3,680.0	3,680.0
Ao Phai Thermal Unit 3	600.0	570.0	3,680.0	3,680.0
<b>Total</b>	<b>3,075.0</b>	<b>2,921.3</b>	<b>19,282.4</b>	<b>19,282.4</b>
<b>TOTAL FUTURE PLANTS</b>	<b>4,418.3</b>	<b>4,141.4</b>	<b>21,524.4</b>	<b>20,867.1</b>
<b>GRAND TOTAL CAPACITY (UP TO 1996)</b>	<b>11,302.3<sup>3/</sup></b>	<b>10,405.1</b>	<b>55,115.8</b>	<b>52,487.4</b>

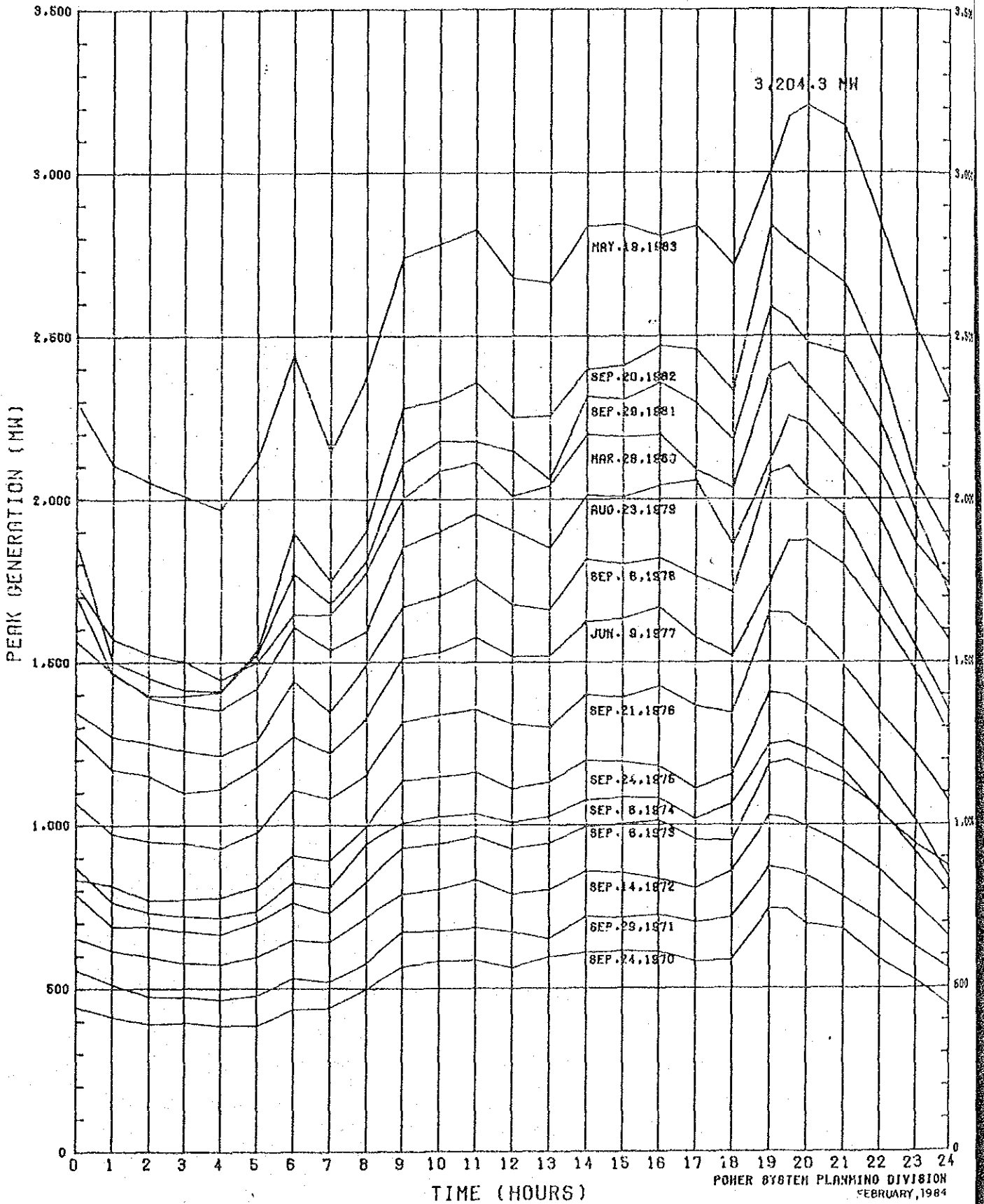
Note : <sup>1/</sup> Existing Power Plants as of February 1984.

<sup>2/</sup> Energy Generated-Pumping Energy. (Pumping Energy for SNR #4, 5 and Bhumibol #8 are 166, 166 and 183 respectively.)

<sup>3/</sup> Total capacity will be reduced to 10,851.2 MW when Krabi (3x20), Gas Turbines (8x15 MW), North Bangkok (237.5 MW) and Diesel (33.6 MW) power plants are retired.

III-3

APPENDIX IV  
 FIGURE IV-1 EGAT TYPICAL DAILY LOAD CURVES OF  
 PEAK DAY (FISCAL YEAR 1970-1983)



TIME (HOURS)

POWER SYSTEM PLANNING DIVISION  
 FEBRUARY, 1984  
 32100-2701-10

APPENDIX V  
ABBREVIATION OF UNITS AND GLOSSARY OF TERMS

ACSR	=	Aluminum Conductor Steel-Reinforced
ADB	=	Asian Development Bank
฿	=	Baht
cms	=	Cubic Meter per Second
EGAT	=	Electricity Generating Authority of Thailand
EHV	=	Extra High Voltage
FY	=	Fiscal Year
GWh	=	Gigawatt-Hour (Million Kilowatt-hours)
HV	=	High Voltage
Hz	=	Hertz
IBRD	=	International Bank for Reconstruction and Development
KFAED	=	Kuwait Fund for Arab Economic Development
KFW	=	Kreditanstalt für Wiederaufbau
km	=	Kilometer
km <sup>2</sup>	=	Square Kilometer
kV	=	Kilovolt
KVA	=	Kilovolt-Ampere
kWh	=	Kilowatt-Hour
LAO PDR	=	Lao People Democratic Republic
LLN	=	Lembaga Letrik Negara Tanah Malayu
m	=	Meter
₱	=	Million Baht
MCM	=	Thousand Circular Mils
m (MSL)	=	Meter above Mean Sea Level
MEA	=	Metropolitan Electricity Authority
MMSCFD	=	Million Standard Cubic Feet Per Day
MVA	=	Megavolt-Ampere
MW	=	Megawatt
NEA	=	National Energy Administration
NEB	=	National Electricity Board of the States of Malaya
NESDB	=	National Economic and Social Development Board
OA/FA	=	Natural Air Cool/Forced Air Cool
OECF	=	The Oversea Economic Cooperation Fund
OPEC	=	Organization of the Petroleum Exporting Countries
PEA	=	Provincial Electricity Authority
RID	=	Royal Irrigational Department
rpm	=	Revolution Per Minute
SFD	=	Saudi Fund for Development
US.\$	=	United States Dollar
VOA	=	Voice of America
¥	=	Yen
yr	=	Year



INVESTIGATION PROGRAM  
HYDROELECTRIC DEVELOPMENT  
IN  
NAM YUAM RIVERBASIN

Water Resources Planning  
and Development Division  
Project Planning and  
Investigation Department  
April 1984





## CONTENT

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INVESTIGATION PROGRAM  
HYDRO-ELECTRIC DEVELOPMENT  
IN  
NAM YUAM RIVERBASIN

1. GOAL

This investigation program is prepared in order to support the informations for studying hydro-electric development in the Nam Yuam river-basin as detailed in report no.32004/2607. The study will deal with a master plan of hydro-electric development and pre-feasibility study of the highest priority sites.

The study will be conducted under technical co-operation between the Government of Thailand by the Electricity Generating Authority of Thailand (EGAT) and the Government of Japan by the Japan International Cooperation Agency (JICA) expected to start in 1985 for the period of 2 years.

The investigations will involve many sectors for instance topography, geology, hydrology, environment etc. However, the investigations stated herein will concern mainly field survey for which identified basin characteristics and whether feasible damsites.

It should be notified that the program stated hereafter is not limited to, it may be either modified or reduced the work program as recommended by the authorities concerned.

## 2. PROGRAM

### 2.1 STAGE 1

Since there are several alternatives at some promising dam-sites underconsidered for further investigations. In order to less field work and saving time, the investigations at this stage will be made to point out the justifiable and feasible alternative sites for further ground survey and drilling.

### 2.2 STAGE 2

In depth investigations of topography, geology and relevant informations of the site selected in stage 1, if any, will be made at this stage. The investigations will be ground survey, drilling, sources of materials, and so on. Those informations will basically support the further study up to feasibility level.

### 3. STAGE 1 OF THE PROGRAM

#### 3.1 Accessibility

- Access road to the proposed damsites as shown in Figures 2 to 5.
- Path walk to alternative damsites (Figures 2 and 3).
- Priority of the access roads is as follows
  - Mae Rit
  - Nam Ngao
  - Nam Yuam and
  - Upper Nam Yuam 1

#### 3.2 Aerial Photograph

- Aerial photograph at scale of 1:30,000 covering all the potential sites of about 2,610 sq.km. as shown in Fig.6.
- Topographic mapping from the aerial photograph at 1:10,000 scale with 5 m contour covering reservoir sur face area as indicated in Fig.6.  
  
The map should reach to 20 m above the normal high water levels.
- If necessary, the aerial photograph will be requested to make the mapping at 1:5,000 scale covering the head work for the purpose of construction lay-out.

Some part of the Nam Yuam riverbasin, the aerial photograph was made by the National Energy Administration (NEA), reprintation of the positive photo should be done. So far as the information compiled, the following aerial photographs are available.

"Sheet 1 of 2"

Flight line	Photo-index	No. of Photographs
Line 1 M-2	86 - 103	18
Line 2 M-2	114 - 129	16
Line 3 M-2	131 - 140	10

"Sheet 2 of 2"

Line 2 M-2	101 - 105	5
Line 1 M-2	111 - 116	6
Line 3 M-2	138 - 154	17
Line 4 M-2	174 - 188	15
Line 5 M-2	156 - 172	17

3.3 Cross-section

- Cross-section of the damsites referenced to the same bench mark.

3.4 Geological Survey

- Surface geologic investigation.
- Photo-interpretation together with field reconnaissance for geologic map of the basin.
- Geologic mapping of damsite and appurtenant structures.
- Structural analysis of rock.

3.5 Seismicity

- All records concerning the earthquake should be compiled for further analysis.

### 3.6 Hydrologic Observation

- To install runoff gaging station at Nam Ngao.
- To verify runoff recorded at Ban Sop Han of the NEA, if the accuracy degree is unacceptable, reinstalling the new gaging station is required.

#### 4. STAGE 2 OF THE PROGRAM

##### 4.1 Mae Rit Damsite

###### a. Topographic Survey

- Topo-map damsite and appurtenant structures at scale of 1:1,000 with 1 m contour about  $0.8 \text{ km}^2$ .
- Topo-map at power tunnel route and powerhouse at scale of 1:1,000 with 1 m contour about  $0.8 \text{ km}^2$ .

###### b. Geologic Investigation

- Subsurface investigation at the dam axis about 3 drill holes of approximately 360 m depth.
- To observe ground water table and permeability test.
- Geological mapping of damsite and appurtenant structures.

###### c. Material

- To locate quarry and borrow area.
- To inspect rock characteristics to be suited for rock material and aggregate.
- At least 5 test pits are required and sample test should be made for
  - gradation
  - water content
  - specific gravity
  - atterberg limits
  - compaction
  - permeability
  - unit weight of wet and dry

- etc. -

#### 4.2 Nam Ngao Damsite

##### a. Topographic Survey

- Topo-map damsite and appurtenant structures at scale 1:1,000 with 1 m contour about 1.2 km<sup>2</sup>.
- Topo-map at power tunnel route and powerhouse at scale of 1:1,000 with 1 m contour about 0.8 km<sup>2</sup>.

##### b. Geologic Investigation

- Subsurface investigation at the dam axis about 5 drill holes of approximately 450 m depth.
- To observe ground water table and permeability test.
- Geological mapping of damsite and appurtenant structures.

##### c. Material

- To locate quarry and borrow area.
- To inspect rock characteristics to be suited for rock material and aggregate.
- At least 8 test pits are required and sample test should be made for :
  - gradation
  - water content
  - specific gravity
  - atterberg limit
  - compaction
  - permeability
  - unit weight of wet and dry

- etc. -



#### 4.3 Upper Nam Yuam 1

##### a. Topographic Survey

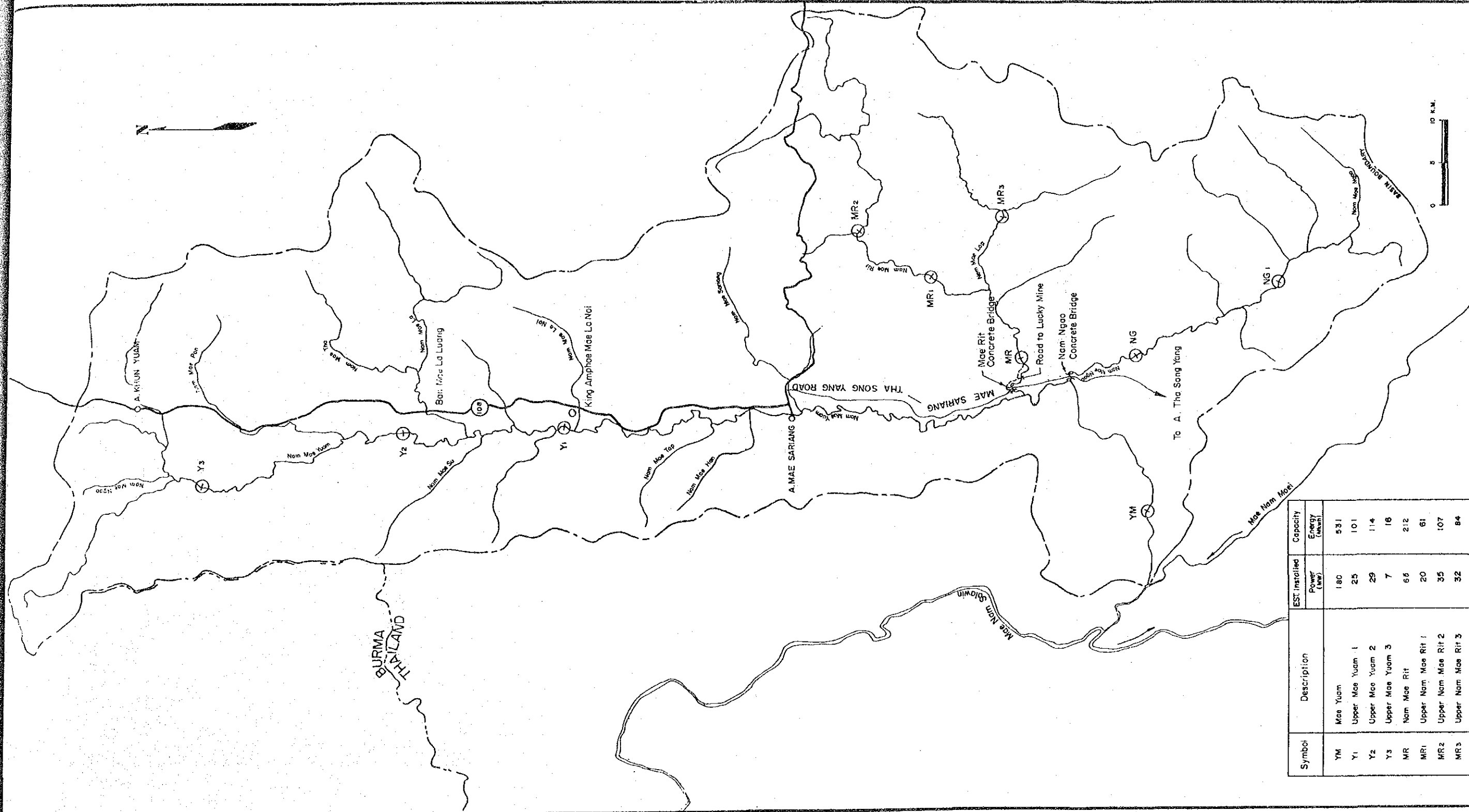
- Topo-map damsite and appurtenant structure at scale of 1:1,000 with 1 m contour about 1.5 km<sup>2</sup>.

##### b. Geologic Investigation

- Subsurface investigation at the dam axis about 3 drill holes of approximately 150 m depth.
- To observe ground water table and permeability test.
- Geological mapping of damsite area.

##### c. Material

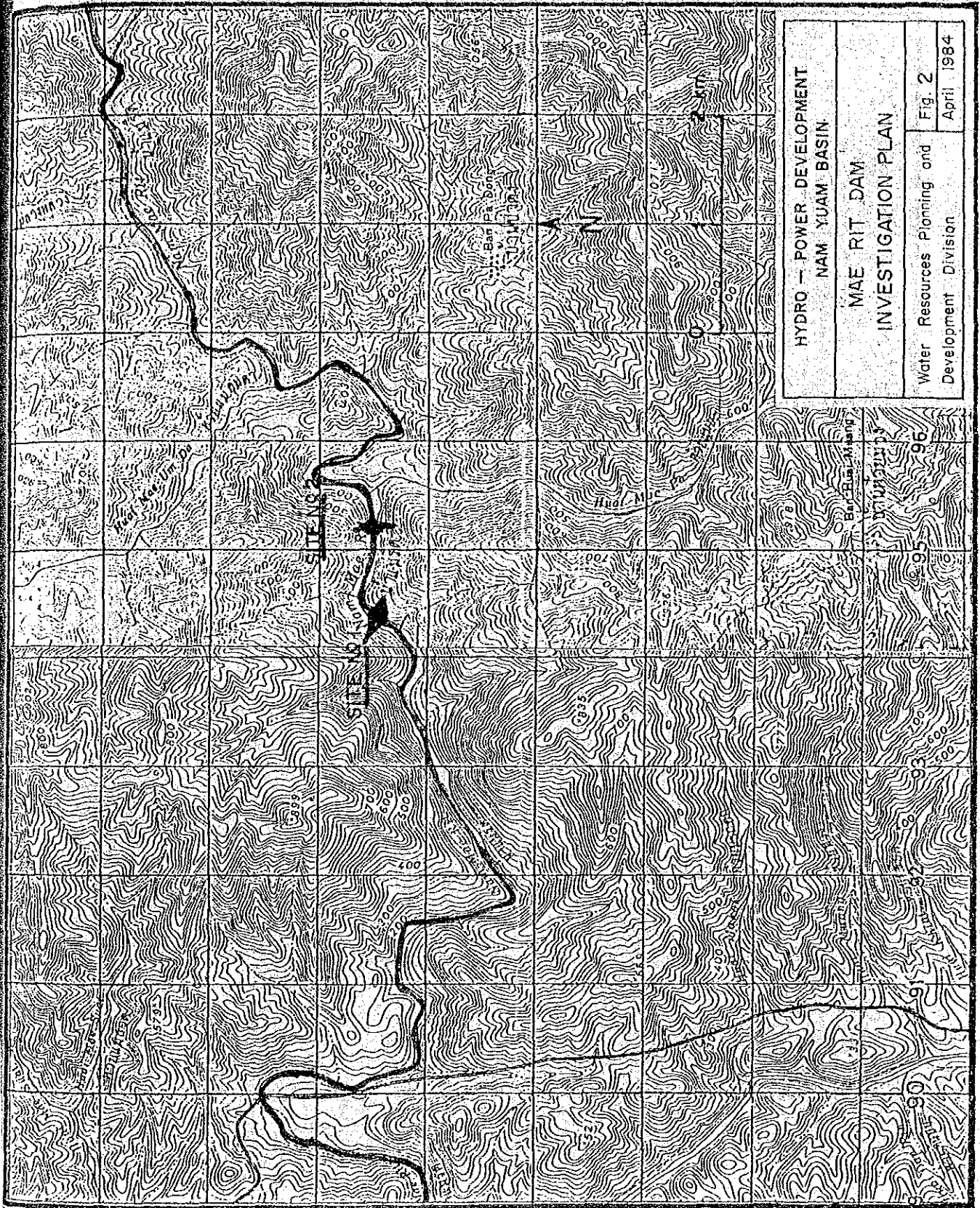
- To locate quarry and borrow area.
- To inspect rock characteristics to be suited for rock material and aggregate.
- At least 10 test pits are required and sample test should be made for
  - gradation
  - water content
  - specific gravity
  - atterberg limit
  - compaction
  - permeability
  - unit weight of wet and dry
  - etc. -

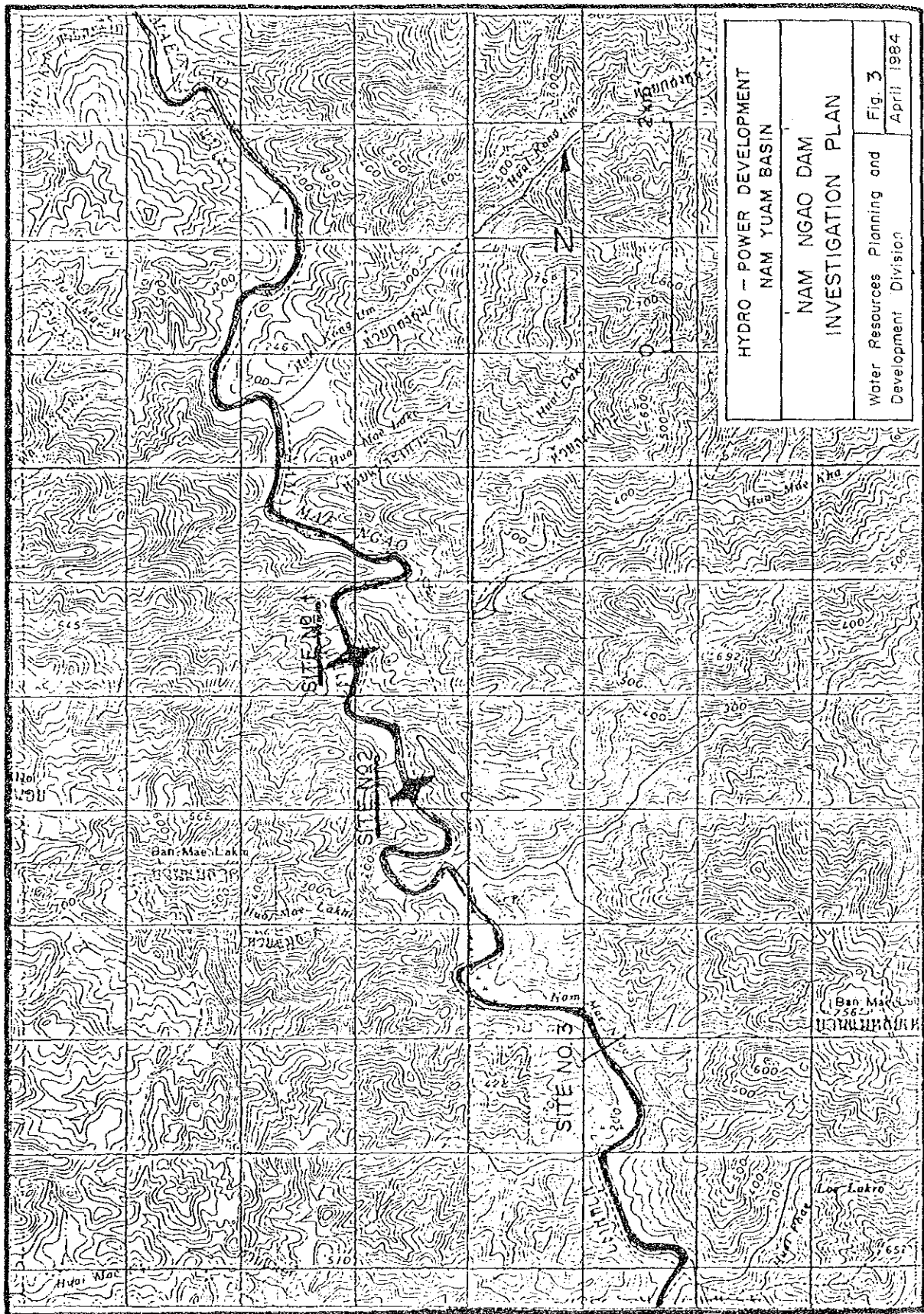


Symbol	Description	EST. installed		Capacity
		Power (MW)	Energy (MWH/yr)	
YM	Mae Yuam	180	531	
Y1	Upper Mae Yuam 1	25	101	
Y2	Upper Mae Yuam 2	29	114	
Y3	Upper Mae Yuam 3	7	16	
MR	Nam Mae Rit	66	212	
MR1	Upper Nam Mae Rit 1	20	61	
MR2	Upper Nam Mae Rit 2	35	107	
MR3	Upper Nam Mae Rit 3	32	84	
NG	Nam Mae Ngao	40	109	
NG1	Upper Nam Mae Ngao 1	22	47	
	Total	485	1362	

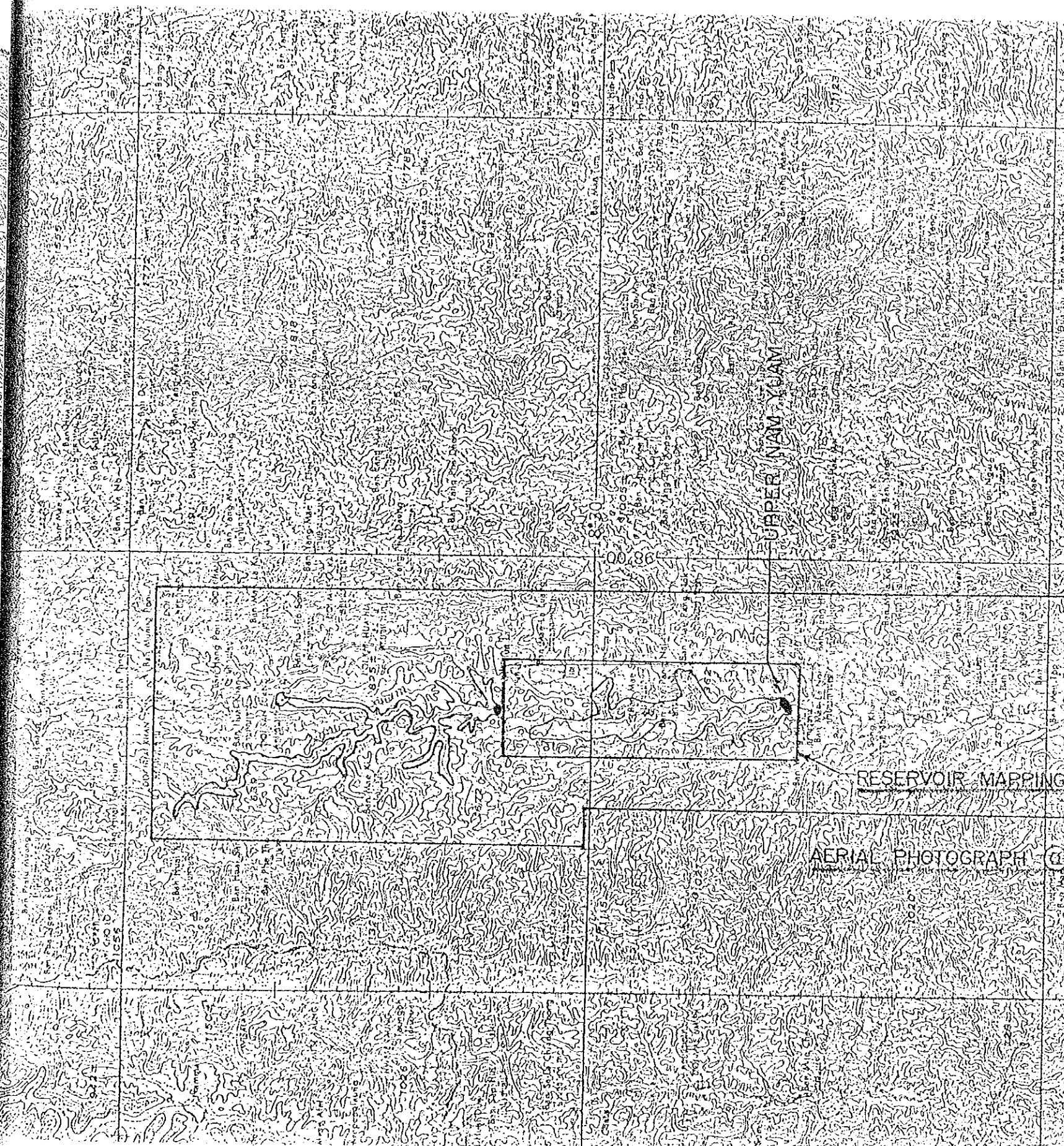
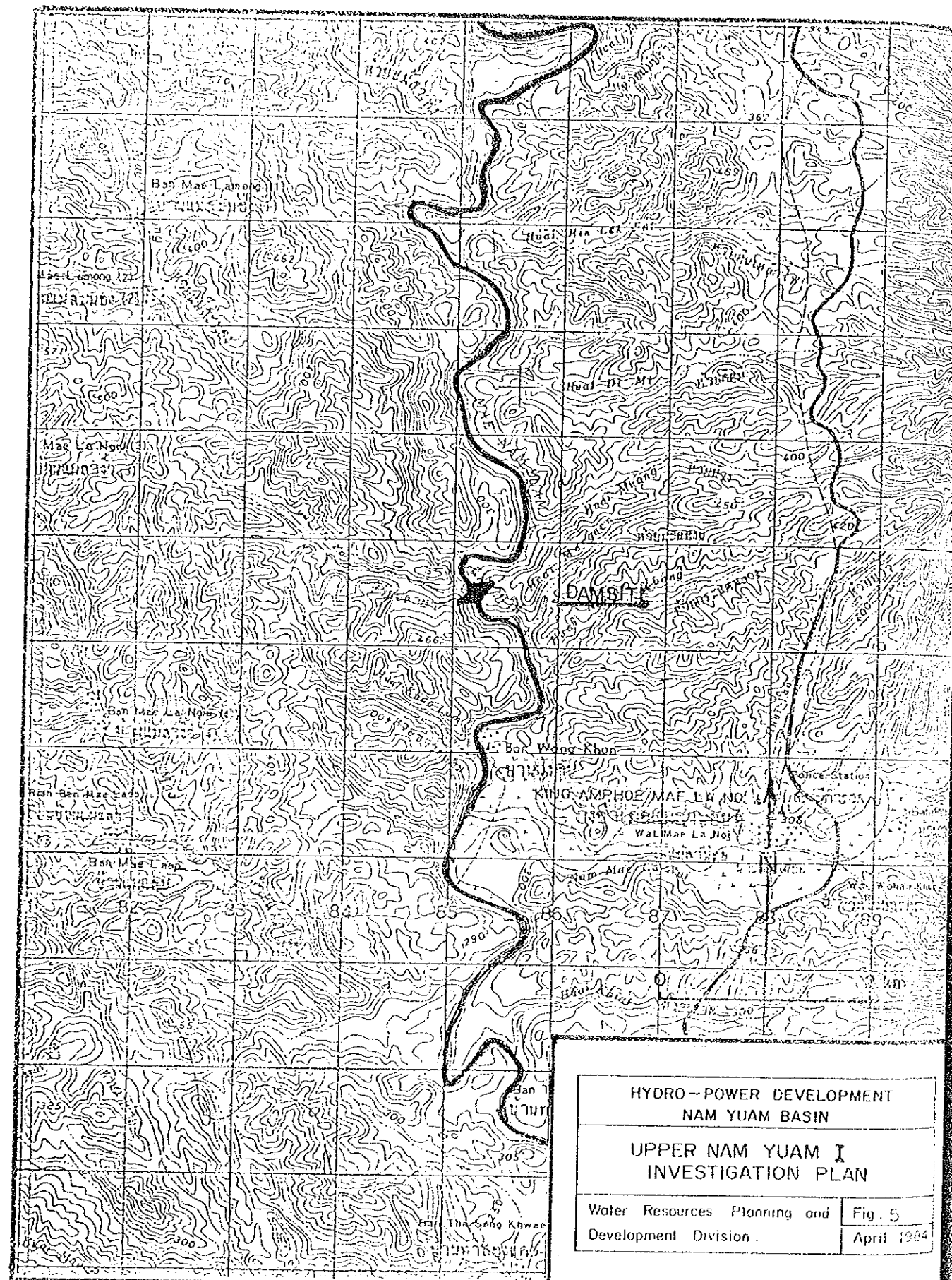
ELECTRICITY GENERATING AUTHORITY OF THAILAND  
 HYDRO-POWER DEVELOPMENT IN NAM YUAM BASIN  
 LOCATION OF HYDRO - POWER POTENTIALS  
 Water Resources Planning and Development Division  
 Project Planning and Investigation Department  
 Fig. 1  
 June 1964



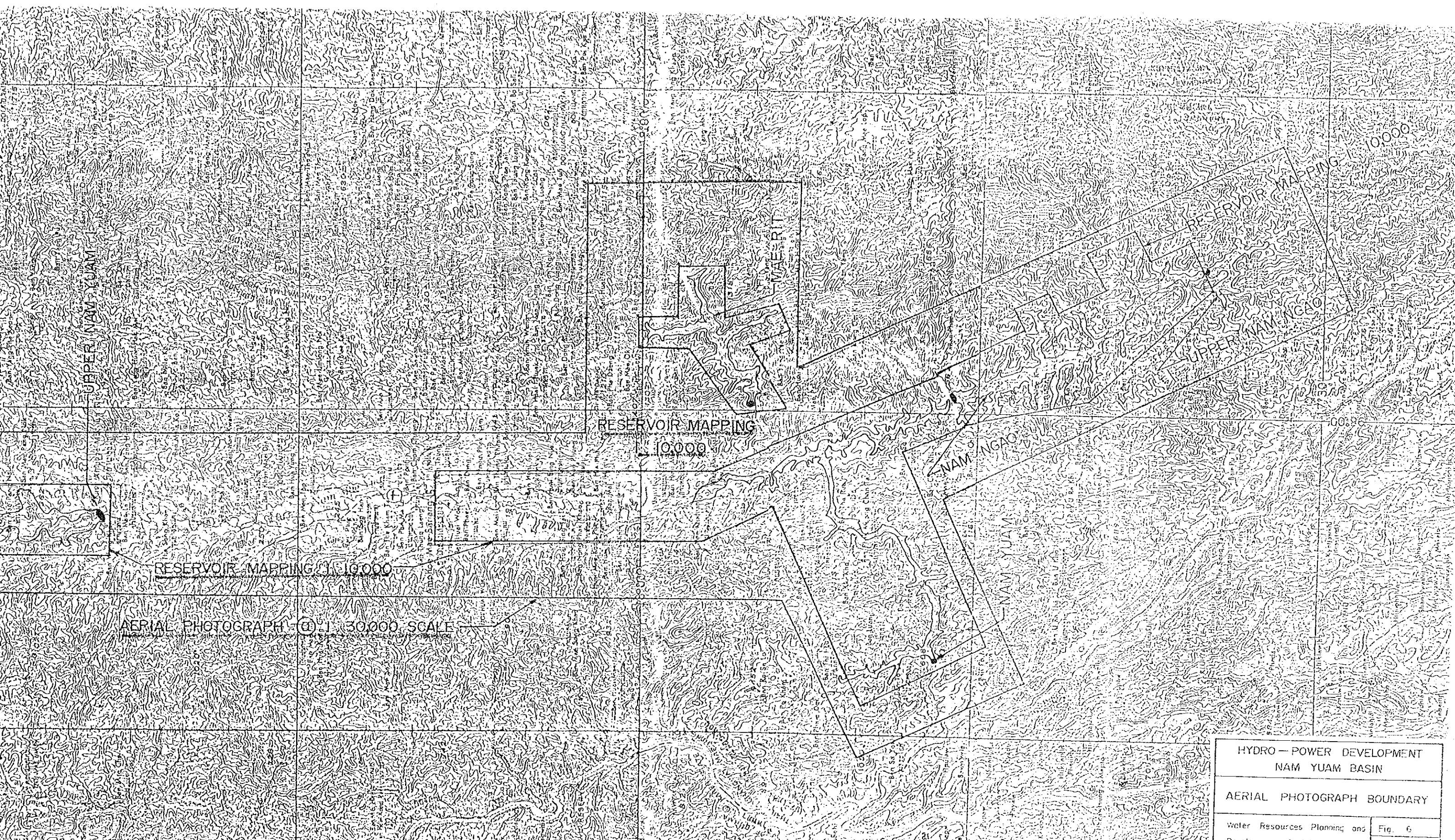








HYDRO-POWER DEVELOPMENT  
 NAM YUAM BASIN  
 UPPER NAM YUAM I  
 INVESTIGATION PLAN  
 Water Resources Planning and Development Division. Fig. 5  
 April 1964



HYDRO — POWER DEVELOPMENT NAM YUAM BASIN	
AERIAL PHOTOGRAPH BOUNDARY	
Water Resources Planning and Development Division	Fig. 6 April, 1984









N - 6 - c)

SUPPLEMENT OF  
"POSSIBLE HYDROELECTRIC DEVELOPMENT  
IN  
NAM YUAM RIVERBASIN  
(RESERVOIR SIMULATION ASPECT)"  
PRELIMINARY STUDY

Water Resources Planning  
and Development Division  
Project Planning and  
Investigation Department  
ECAT  
February 1984

## HYDRO POWER POTENTIAL

IN

### MAE NAM YUAM BASIN

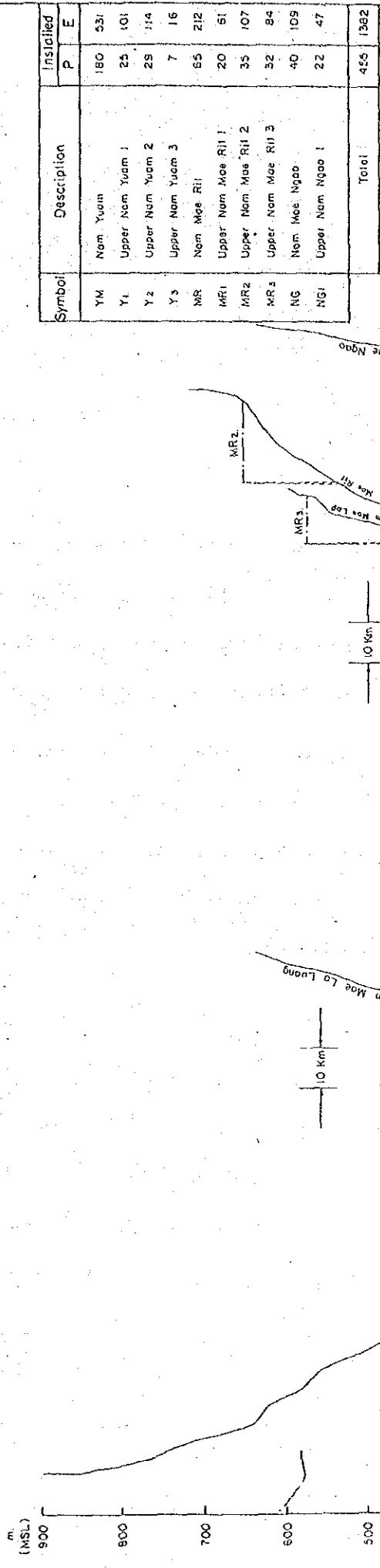
Region : North

Changwat : Mae Hongson

Project No.	Project Name	Amphoe	Location N°-E°	Type of Project	Drainage Area (K <sup>2</sup> m <sup>2</sup> )	Est. Avg. Stream Flow (MCM)	Est. Avg. Ann. Inflow (MCM)	Res. Storage Capacity (MCM)		Dam Height (m)	Avg. Head (m)	Installed Capacity and Energy Production		Construction Cost. M฿	Prelim B/C Ratio
								NHWL	MIN. WL.			Power(MW)	Ann. Energy(MkWh)		
1	Mae Yuam (NEA)	Mae Sariang	17-47, 97-49	C	5920	94.0	2969	435	75.6	116	73	180	531	5031	1.71
2	Upper Mae Yuam 1	Mae La Noi	18-41, 97-52	C	1967	19.4	612	405	55	76	53	25	101	1379	1.12
3	Upper Mae Yuam 2	Mae La Noi	18-33, 97-54	C	1149	11.3	357	570	115	102	77	29	114	1565	0.87
4	Upper Mae Yuam 3	Khun Yuam	18-23, 97-55	C	447	4.4	139	120	50	62	49	7	16	535	0.61
5	Nam Mae Rit	Mae Sariang	17-55, 98-01	C	1268	19.3	610	418	224	145	129	65	212	2385	1.43
6	Upper Nam Mae Rit 1	Mae Sariang	18-00, 98-04	C	686	10.5	330	86	18	98	100	20	61	1279	0.75
7	Upper Nam Mae Rit 2	Mae Sariang	18-05, 98-06	C	525	8.0	253	220	50	140	193	35	107	2375	0.71
8	Upper Nam Mae Rit 3	Mae Sariang	17-57, 98-08	C	349	5.3	168	180	64	125	181	32	84	2676	0.51
9	Nam Mae Ngao	Mae Sariang	17-48, 97-05	C	335	17.4	550	680	270	72	61	40	109	1414	1.28
10	Upper Nam Mae Ngao	Mae Sariang	17-39, 98-05	C	490	10.2	323	525	200	98	63	22	47	1049	0.76
Total												455	1382		







Symbol	Description	Installed	
		P	E
YM	Nam Yuam	180	53
Y1	Upper Nam Yuam 1	25	101
Y2	Upper Nam Yuam 2	29	114
Y3	Upper Nam Yuam 3	7	16
MR	Nam Moei Rii	65	212
MR1	Upper Nam Moei Rii 1	20	61
MR2	Upper Nam Moei Rii 2	35	107
MR3	Upper Nam Moei Rii 3	32	84
NG	Nam Moei Ngao	40	109
NG1	Upper Nam Ngao 1	22	47
Total		455	1382

LEGEND

Preferenceability Study Site

Potential Site

10 Km

Distance = 10 Km, Unit Measured of Yuam Tributary from Yuam and Yuam Tributary Confluence

ELECTRICITY GENERATING AUTHORITY OF THAILAND

HYDRO-POWER DEVELOPMENT IN NAM YUAM BASIN

PROFILE ALONG NAM MAE YUAM AND TRIBUTARIES

Water Resources Planning and Development Division  
Project Planning and Investigation Department

Fig. 2  
Nov 1982



Supplement of  
Possible Hydroelectric Development  
in  
Nam Yuam Riverbasin

1. purpose?

This report is prepared supplementary to the preliminary study of "Possible Hydroelectric Development in Nam Yuam riverbasin" conducted in January 1984. It is an ambition to reveal the hydro-power potential in this basin of those are not mentioned in the preliminary report.

The basin characteristics, themselves provide the advantageous features for hydro-power source, a plentiful rainfall, mountainous area, steep channel slope, good rock and less environmental impact etc. However, some environmental impact is inevitable. The comparison of the two and solving the problems will be made in the next step.

2. Big Potential?

As roughly estimate had been done so far, there are 10 potential sites in the basin as illustrated in Table 1 and Figure 1 and 2. The potential power production would be about 455 MW expected to produce average annual energy of 1,296 MkWh. Of this power potential even some of them would relieve the burden of the EGAT in importing fuel for others sources.

General description of each site is attached in the following pages.

HYDRO-ELECTRIC DEVELOPMENT IN NAM YUAM RIVER BASIN

NAM YUAM PROJECT

GENERAL DESCRIPTION

LOCATION : On the Yuam river, at Ban Tha Rua Pha Lae  
 Amphoe Mae Sariang, Mae Hong Son province,  
 latitude 18°- 47'N and longitude 97°- 49'E.

BASIN CHARACTERISTIC

Catchment Area	:	5,770	km <sup>2</sup>
Average Annual Rainfall	:	1,168	mm
Average Annual Runoff	:	2,969	MCM

RESERVOIR

Maximum Water Level	:	173.5	m (MSL)
Normal High Water Level (NHWL)	:	170	m (MSL)
Minimum Water Level	:	140	m (MSL)
Available Drawdown	:	30	m
Storage Capacity at NHWL	:	435	MCM
Dead Storage Capacity	:	75.6	MCM
Effective Storage Capacity	:	359.4	MCM
Reservoir Surface Area at NHWL	:	22	km <sup>2</sup>

DAM

Type	:	Rockfill with central imper- vious core
Crest Elevation	:	175 m (MSL)

DAM (cont.)

Height : 116 m  
Length : 500 m  
Volume : 5,310,000 m<sup>3</sup>

SPILLWAY

Type : Over chute spillway  
Design Flood : 5,715 cms  
Spillway Capacity : 2,850 cms

POWER CONDUIT

Headrace Tunnel

Length : 120 m  
Diameter : 5.0 m

Penstock

Length : 414 m  
Diameter : 5.0 m

POWER GENERATING

Installed Capacity : 3 x 60 MW

Turbine

Type : Francis  
Output : 64,000 kW  
Maximum Discharge : 97.93 cms  
Effective Head : 73 m  
Speed : 214 rpm

Generator

Type : 3 phase, A.C. synchronous

POWER GENERATING (cont.)

Generator

Capacity	:	69,100	kVA
Frequency	:	50	Hz
Average Annual Energy	:	531	MkWh

TRANSMISSION LINE

Voltage - Route	:	(a) 230 kV single circuit Nam Yuam - Mae Rit
	:	(b) 230 kV double circuit Mae Rit - Mae Moh

Length	:	200	km
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CONSTRUCTION COST (1983 price level)	:	5,031	M₪
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ECONOMY

B/C	:	1.71	
Annual B-C	:	345	M₪
IRR	:	18.67	%

NAM YUAM HYDRO-ELECTRIC DEVELOPMENT

Upper Nam Yuam I

GENERAL DESCRIPTION

LOCATION : on the Nam Mae Yuam River, 44 km by the river to the Northward of Amphoe Mae Sariang, at the latitude 18° 23' 30" N and longitude 97° 55' 00" E (approximately)

BASIN CHARACTERISTIC

Catchment Area	:	1,967	km <sup>2</sup>
Average Annual Rainfall	:	1,254	mm
Average Annual Runoff	:	806	MCM

RESERVOIR

Maximum Water Level	:	328	m (MSL)
Normal High Water Level (NHWL)	:	325	m (MSL)
Minimum Water Level	:	295	m (MSL)
Available Drawdown	:	30	m
Storage Capacity at NHWL	:	405	MCM
Dead Storage Capacity	:	55	MCM
Effective Storage Capacity	:	350	MCM
Reservoir Surface Area at NHWL	:	21	km <sup>2</sup>

DAM

Type	:	Rockfill with central Impervious core
Crest Elevation	:	330 m (MSL)

DAM (cont.)

Height	:	76	m
Length	:	520	m
Volume	:	1,395,000	m <sup>3</sup>

SPILLWAY

Type	:	chute type with radial gate	
Design Flood	:	3,750	cms
Spillway Capacity	:	1,800	cms

POWER CONDUIT

Headrace Tunnel

Length	:	-	m
Diameter	:	-	m

Penstock

Length	:	300	m
Diameter	:	3.5	m

POWER GENERATING

Installed Capacity	:	1 x 25	MW
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Turbine

Type	:	Francis	
Output	:	26,300	kW
Maximum Discharge	:	55.8	cms
Effective Head	:	53.4	m
Speed	:	250	rpm

Generator

Type	:	3 phase, A.C. synchronous	
Capacity	:	28,400	kVA
Frequency	:	50	Hz

POWER GENERATING (cont.)

Average Annual Energy : 100.7 MkwH

TRANSMISSION LINE

Voltage : 115 kV

Route : Connecting with the Nam  
Mae Rit Power Station

Length : 52 km

CONSTRUCTION COST (1983 Price Level) : 1,379 M฿

ECONOMY

B/C : 1.12

Annual B-C : 16 M฿

IRR : 11.53 %

NAM YUAM HYDRO-ELECTRIC DEVELOPMENT

Upper Nam Yuam II

GENERAL DESCRIPTION

LOCATION : On the river Nam Mae Yuam at  
 Latitude 18° 33' N  
 Longitude 97° 55' E

BASIN CHARACTERISTIC

Catchment Area	: 1,149	km <sup>2</sup>
Average Annual Rainfall	: 1,200	mm
Average Annual Runoff	: 357	MCM

RESERVOIR

Maximum Water Level	: 420	m (MSL)
Normal High Water Level (NHWL)	: 417	m (MSL)
Minimum Water Level	: 380	m (MSL)
Available Drawdown	: 37	m
Storage Capacity at NHWL	: 590	MCM
Dead Storage Capacity	: 115	MCM
Effective Storage Capacity	: 455	MCM
Reservoir Surface Area at NHWL	: 21	km <sup>2</sup>

DAM

Type	: Rockfill with impervious core
Crest Elevation	: 422 m (MSL)



DAM (cont.)

Height : 102 m  
Length : 412 m  
Volume : 3,700,000 m<sup>3</sup>

SPILLWAY

Type : Over Chute  
Design Flood : 2,650 cms  
Spillway Capacity : 1,350 cms

POWER CONDUIT

Headrace Tunnel

Length : — m  
Diameter : — m

Penstock

Length : 250 m  
Diameter : 2.80 m

POWER GENERATING

Installed Capacity : 29 MW

Turbine

Type : Francis  
Output : 30,500 kW  
Maximum Discharge : 45.4 cms  
Effective Head : 76.9 m  
Speed : 300 rpm

Generator

Type : 3 phase, AC synchronous  
Capacity : 34,100 kVA  
Frequency : 50 Hz

POWER GENERATING (cont.)

Average Annual Energy : 114.3 MkwH

TRANSMISSION LINE

Voltage : 115 kV

Route : 1, connecting with 115 kV/sc  
of Upper Yuam 1 Transmission Line

Length : 18 km

CONSTRUCTION COST (1984 Price Level) : 1,565 ME

ECONOMY

B/C : 0.87

Annual B-C : -20.34 ME

NAM YUAM HYDRO-ELECTRIC DEVELOPMENT

Upper Nam Yuam III

GENERAL DESCRIPTION

LOCATION : On the river Nam Mae Yuam at  
 Latitude 41° 12' N  
 Longitude 97° 52' E

BASIN CHARACTERISTIC

Catchment Area	: 447	km <sup>2</sup>
Average Annual Rainfall	: 1,200	mm
Average Annual Runoff	: 139.0	MCM
	(4.41)	cms

RESERVOIR

Maximum Water Level	: 480	m (MSL)
Normal High Water Level (NHWL)	: 477	m (MSL)
Minimum Water Level	: 456	m (MSL)
Available Drawdown	: 20	m
Storage Capacity at NHWL	: 120	MCM
Dead Storage Capacity	: 50	MCM
Effective Storage Capacity	: 90	MCM
Reservoir Surface Area at NHWL	: 65	km <sup>2</sup>

DAM

Type	: Rockfill, with Impervious core
Crest Elevation	: 482 m (MSL)

DAM (cont.)

Height : 62 m  
Length : 159 m  
Volume : 700,000 m<sup>3</sup>

SPILLWAY

Type : Over Chute  
Design Flood : 1,300 cms  
Spillway Capacity : 700 cms

POWER CONDUIT

Headrace Tunnel

Length : m  
Diameter : m

Penstock

Length : 150 m  
Diameter : 2.10 m

POWER GENERATING

Installed Capacity : 7.2 MW

Turbine

Type : Francis  
Output : 7,600 kW  
Maximum Discharge : -17.64 cms  
Effective Head : 48.8 m  
Speed : 500 rpm

Generator

Type : 3 phase, AC synchronous  
Capacity : 8,500 kVA  
Frequency : 50 Hz

POWER GENERATING (cont.)

Average Annual Energy : 157 MWh

TRANSMISSION LINE

Voltage : 115 kV

Route : 1, connecting with 115 kV/sc  
of Upper Yuam II, Transmission  
Line

Length : 29 km

CONSTRUCTION COST (1984 Price Level) : 535 M\$

ECONOMY

B/C : 0.61

Annual B-C : -20.62 M\$

## HYDRO-ELECTRIC DEVELOPMENT IN NAM YUAM RIVER BASIN

### NAM NGAO PROJECT

#### GENERAL DESCRIPTION

LOCATION : On the Ngao river, the tributary of the Yuam river, approximately 42 km southward of Amphoe Mae Sariang, Mae Hong Son province at the latitude  $17^{\circ} 48' N$  and longitude  $97^{\circ} 59' E$

#### BASIN CHARACTERISTIC

Catchment Area	:	835	km <sup>2</sup>
Average Annual Rainfall	:	1587	mm
Average Annual Runoff	:	787	MCM

#### RESERVOIR

Maximum Water Level	:	243.5	m (MSL)
Normal High Water Level (NHWL)	:	240	m (MSL)
Minimum Water Level	:	215	m (MSL)
Available Drawdown	:	25	m
Storage Capacity at NHWL	:	680	MCM
Dead Storage Capacity	:	270	MCM
Effective Storage Capacity	:	410	MCM
Reservoir Surface Area at NHWL	:	20	km <sup>2</sup>

#### DAM

Type	:	Rockfill with central impervious core
Crest Elevation	:	245 m (MSL)

DAM (cont.)

Height	:	72	m
Length	:	520	m
Volume	:	2,010,000	m <sup>3</sup>

SPILLWAY

Type	:	Over chute spillway	
Design Flood	:	2609	cms
Spillway Capacity	:	1300	cms

POWER CONDUIT

Headrace Tunnel

Length	:	1570	m
Diameter	:	4.7	m

Penstock

Length	:	105	m
Diameter	:	4.25	m

POWER GENERATING

Installed Capacity	:	2 x 20	MW
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Turbine

Type	:	Francis	
Output	:	2 x 21,000	kW
Maximum Discharge	:	78.1	cms
Effective Head	:	61.1	m
Speed	:	300	rpm

Generator

Type	:	3 phase, A.C. synchronous
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POWER GENERATING (cont.)

Generator

Capacity	:	2 x 22,700	kVA
Frequency	:	50	Hz
Average Annual Energy	:	108.7	MkWh

TRANSMISSION LINE

Voltage	:	115 kV single circuit
Route	:	Nam Ngao - Mae Rit
Length	:	25 km
CONSTRUCTION COST (1983 price level)	:	1,414 M\$

ECONOMY

B/C	:	1.28
Annual B-C	:	38 M\$
IRR	:	13.43 %



NAM YUAM HYDRO-ELECTRIC DEVELOPMENT

Upper Nam Mae Ngao

GENERAL DESCRIPTION

LOCATION : On the river Nam Mae Ngao, 23 km  
upstream of Ngao Damsite at  
Latitude 17° 39' N  
Longitude 98° 05' E

BASIN CHARACTERISTIC

Catchment Area	: 490	km <sup>2</sup>
Average Annual Rainfall	: 1,600	mm
Average Annual Runoff	: 323	MCM

RESERVOIR

Maximum Water Level	: 321	m (MSL)
Normal High Water Level (NHWL)	: 318	m (MSL)
Minimum Water Level	: 288	m (MSL)
Available Drawdown	: 30	m
Storage Capacity at NHWL	: 525	MCM
Dead Storage Capacity	: 200	MCM
Effective Storage Capacity	: 325	MCM
Reservoir Surface Area at NHWL	: 14	km <sup>2</sup>

DAM

Type	: Rockfill with impervious core
Crest Elevation	: 323 m (MSL)

DAM (cont.)

Height	:	98	m
Length	:	276	m
Volume	:	2,100,000	m <sup>3</sup>

SPILLWAY

Type	:	Over Chute	
Design Flood	:	1,370	cms
Spillway Capacity	:	750	cms

POWER CONDUIT

Headrace Tunnel

Length	:		m
Diameter	:		m

Penstock

Length	:	200	m
Diameter	:	3.84	m

POWER GENERATING

Installed Capacity	:	21.5	MW
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Turbine

Type	:	Francis	
Output	:	22,600	kW
Maximum Discharge	:	40.90	cms
Effective Head	:	63.00	m
Speed	:	330	rpm

Generator

Type	:	3 phase, AC, synchronous	
Capacity	:	23,800	kVA
Frequency	:	50	Hz

POWER GENERATING (cont.)

Average Annual Energy : 47.17 MWh

TRANSMISSION LINE

Voltage : 115 kV

Route : 1 Connecting with 115 kV/sc  
of Nam Mae Ngao Transmission  
Line

Length : 18.0 km

CONSTRUCTION COST (1984 Price Level) : 1,049 M฿

ECONOMY

B/C : 0.76

Annual B-C : -23.86 M฿

NAM YUAM HYDRO-ELECTRIC DEVELOPMENT

MAE RIT PROJECT

GENERAL DESCRIPTION

LOCATION : On the Mae Rit river, the tributary of the Nam Yuam river, 50 km southward of Amphoe Mae Sariang, Mae Hong Son Province, approximately at latitude  $17^{\circ} 55'$  N and longitude  $98^{\circ} 01'$  E

BASIN CHARACTERISTIC

Catchment Area	:	1268	km <sup>2</sup>
Average Annual Rainfall	:	1446	mm
Average Annual Runoff	:	722	MCM

RESERVOIR

Maximum Water Level	:	333	m (MSL)
Normal High Water Level (NHWL)	:	332	m (MSL)
Minimum Water Level	:	300	m (MSL)
Available Drawdown	:	30	m
Storage Capacity at NHWL	:	418	MCM
Dead Storage Capacity	:	224	MCM
Effective Storage Capacity	:	194	MCM
Reservoir Surface Area at NHWL	:	7.6	km <sup>2</sup>

DAM

Type	:	Rockfill with central clay core
Crest Elevation	:	335 m (MSL)

DAM (cont.)

Height : 145 m  
Length : 340 m  
Volume : 5,875,000 m<sup>3</sup>

SPILLWAY

Type : Over chute spillway  
Design Flood : 3185 cms  
Spillway Capacity : 1590 cms

POWER CONDUIT

Headrace Tunnel

Length : 800 m  
Diameter : 4.1 m

Penstock

Length : 223 m  
Diameter : 3.7 m

POWER GENERATING

Installed Capacity : 2 x 32.5 MW

Turbine

Type : Francis  
Output : 34,000 kW  
Maximum Discharge : 30.0 cms  
Effective Head : 129 m  
Speed : 375 rpm

Generator

Type : 3 phase A.C. synchronous  
Capacity : 36,700 kVA  
Frequency : 50 Hz

POWER GENERATING (cont.)

Average Annual Energy : 212.2 MkwH

TRANSMISSION LINE

Voltage : 230 kV

Route : Power station at Mae Rit  
will be a central operating  
of this region

Length : - km

CONSTRUCTION COST (1983 Price Level) : 2,385 M฿

ECONOMY

B/C : 1.43

Annual B-C : 97 M฿

IRR : 15.14 %

NAM YUAM HYDRO-ELECTRIC DEVELOPMENT

Upper Nam Mae Rit I

GENERAL DESCRIPTION

LOCATION : On the river Nam Mae Rit at  
 Latitude 17° 55' N  
 Longitude 98° 01' E

BASIN CHARACTERISTIC

Catchment Area	: 686	km <sup>2</sup>
Average Annual Rainfall	: 1,400	mm
Average Annual Runoff	: 330	MCM

RESERVOIR

Maximum Water Level	: 443	m (MSL)
Normal High Water Level (NHWL)	: 440	m (MSL)
Minimum Water Level	: 400	m (MSL)
Available Drawdown	: 40	m
Storage Capacity at NHWL	: 86	MCM
Dead Storage Capacity	: 18	MCM
Effective Storage Capacity	: 68	MCM
Reservoir Surface Area at NHWL	: 2.55	km <sup>2</sup>

DAM

Type	: Rockfill with Impervious core
Crest Elevation	: 445 m (MSL)

DAM (cont.)

Height	:	98	m
Length	:	296	m
Volume	:	1.99	m <sup>3</sup>

SPILLWAY

Type	:	Over Chute	
Design Flood	:	1852	cms
Spillway Capacity	:	950	cms

POWER CONDUIT

Headrace Tunnel

Length	:	1,350	m
Diameter	:	4.36	m

Penstock

Length	:	400	m
Diameter	:	2.68	m

POWER GENERATING

Installed Capacity	:	20	MW
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Turbine

Type	:	Francis	
Output	:	20,950	kW
Maximum Discharge	:	22.4	cms
Effective Head	:	100.5	m
Speed	:	441	rpm

Generator

Type	:	3 phase, Ac. Synchronous	
Capacity	:	22,200	kVA
Frequency	:	50	Hz



POWER GENERATING (cont.)

Average Annual Energy : 61.30 MWh

TRANSMISSION LINE

Voltage : 115 kV

Route : 1, Connecting with 230 kV/DC  
Transmission Line of Nam Mae  
Rit

Length : 9.5 km

CONSTRUCTION COST (1984 Price Level) : 1,279 M฿

ECONOMY

B/C : 0.75

Annual B-C : -29.9 M฿

# NAM YUAM HYDRO-ELECTRIC DEVELOPMENT

Upper Nam Mae Rit II

## GENERAL DESCRIPTION

LOCATION : On the river Nam Mae Rit, at  
Latitude 18° 05' N  
Longitude 98° 06' E

## BASIN CHARACTERISTIC

Catchment Area	: 525	km <sup>2</sup>
Average Annual Rainfall	: 1,400	mm
Average Annual Runoff	: 253	MCM

## RESERVOIR

Maximum Water Level	: 648	m (MSL)
Normal High Water Level (NHWL)	: 645	m (MSL)
Minimum Water Level	: 595	m (MSL)
Available Drawdown	: 50	m
Storage Capacity at NHWL	: 220	MCM
Dead Storage Capacity	: 50	MCM
Effective Storage Capacity	: 190	MCM
Reservoir Surface Area at NHWL	: 5.75	km <sup>2</sup>

## DAM

Type	: Rockfill with impervious core
Crest Elevation	: 650 m (MSL)

DAM (cont.)

Height	:	140	m
Length	:	310	m
Volume	:	4,800,000	m <sup>3</sup>

SPILLWAY

Type	:	Over Chute	
Design Flood	:	1,470	cms
Spillway Capacity	:	700	cms

POWER CONDUIT

Headrace Tunnel

Length	:	2,300	m
Diameter	:	4.28	m

Penstock

Length	:	500	m
Diameter	:	2.80	m

POWER GENERATING

Installed Capacity	:	2 x 17.5	MW
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Turbine

Type	:	Francis	
Output	:	18,420	kW
Maximum Discharge	:	21.6	cms
Effective Head	:	192.5	m
Speed	:	600	rpm

Generator

Type	:	3 phase, AC. synchronous	
Capacity	:	19,500	kVA
Frequency	:	50	Hz

POWER GENERATING (cont.)

Average Annual Energy : 107.3 MWh

TRANSMISSION LINE

Voltage : 115 kV

Route : 1 Connecting with 115 kV/sc  
Transmission Line of Upper  
Nam Mae Rit I

Length : 22 km

CONSTRUCTION COST (1984 Price Level) : 2,375 M฿

ECONOMY

B/C : 0.71

Annual B-C : -64.4 M฿

NAM YUAM HYDRO-ELECTRIC DEVELOPMENT

Upper Nam Mae Rit III

GENERAL DESCRIPTION

LOCATION : On the river Nam Mae Lop at  
 Latitude 17° 57'  
 Longitude 98° 08'

BASIN CHARACTERISTIC

Catchment Area	:	349	km <sup>2</sup>
Average Annual Rainfall	:	1,400	mm
Average Annual Runoff	:	168	MCM

RESERVOIR

Maximum Water Level	:	530	m (MSL)
Normal High Water Level (NHWL)	:	527	m (MSL)
Minimum Water Level	:	487	m (MSL)
Available Drawdown	:	40	m
Storage Capacity at NHWL	:	180	MCM
Dead Storage Capacity	:	64	MCM
Effective Storage Capacity	:	116	MCM
Reservoir Surface Area at NHWL	:	3.80	km <sup>2</sup>

DAM

Type	:	Rockfill with impervious core
Crest Elevation	:	532 m (MSL)

DAM (cont.)

Height : 125 m  
Length : 440 m  
Volume : 4,900,000 m<sup>3</sup>

SPILLWAY

Type : Over Chute  
Design Flood : 1,047 cms  
Spillway Capacity : 550 cms

POWER CONDUIT

Headrace Tunnel

Length : 3,350 m  
Diameter : 42.6 m

Penstock

Length : 400 m  
Diameter : 2.78 m

POWER GENERATING

Installed Capacity : 32 MW

Turbine

Type : Francis  
Output : 33,900 kW  
Maximum Discharge : 21.3 cms  
Effective Head : 181 m  
Speed : 350 rpm

Generator

Type : 3 phase AC. synchronous  
Capacity : 37,600 kVA  
Frequency : 50 Hz

POWER GENERATING (cont.)

Average Annual Energy : 84 MWh

TRANSMISSION LINE

Voltage : 115 kV

Route : 1 Connecting with 230 kV/DC  
Transmission Line of Nam Mae Rit

Length : 13.5 km

CONSTRUCTION COST (1984 Price Level) : 2,676 M฿

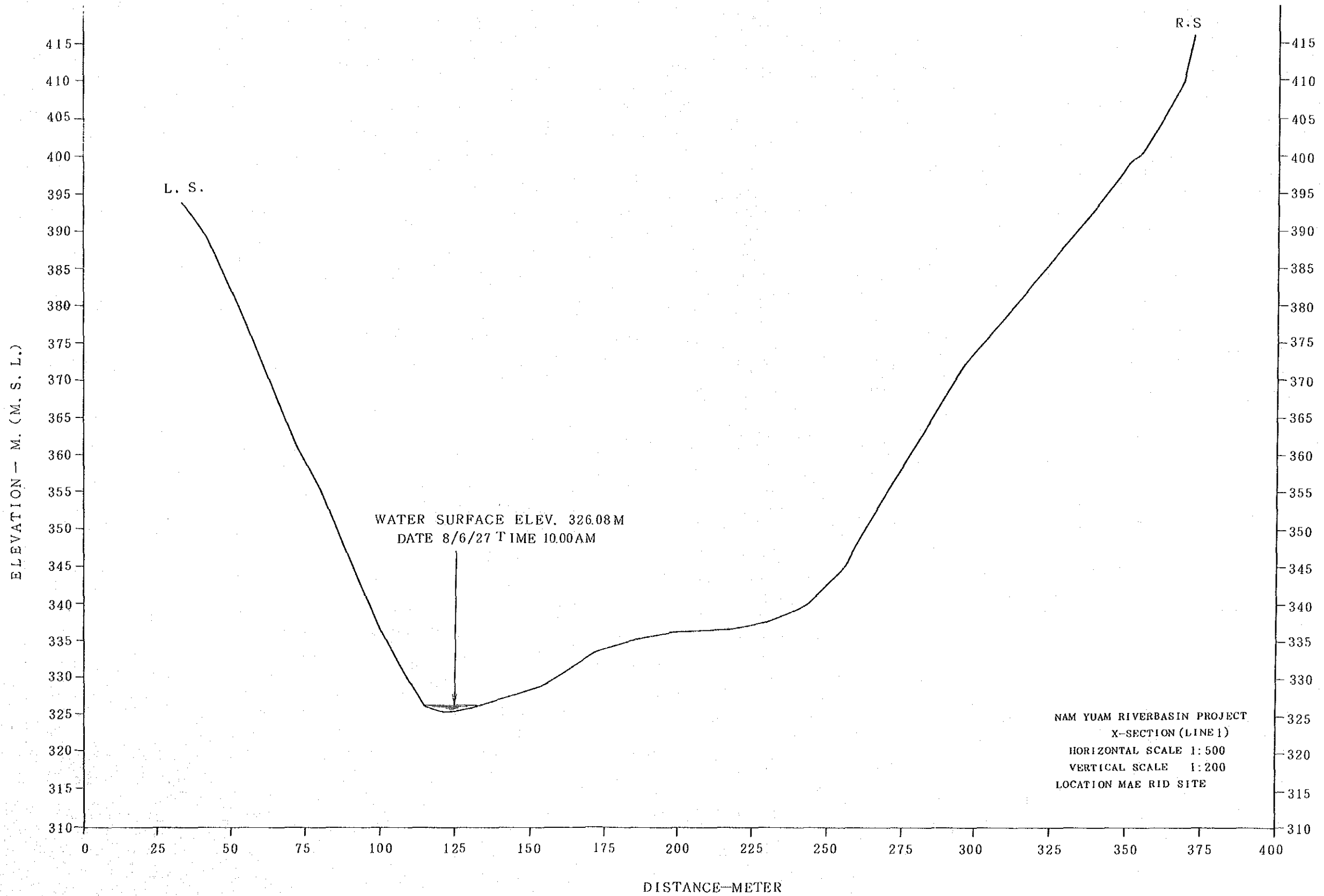
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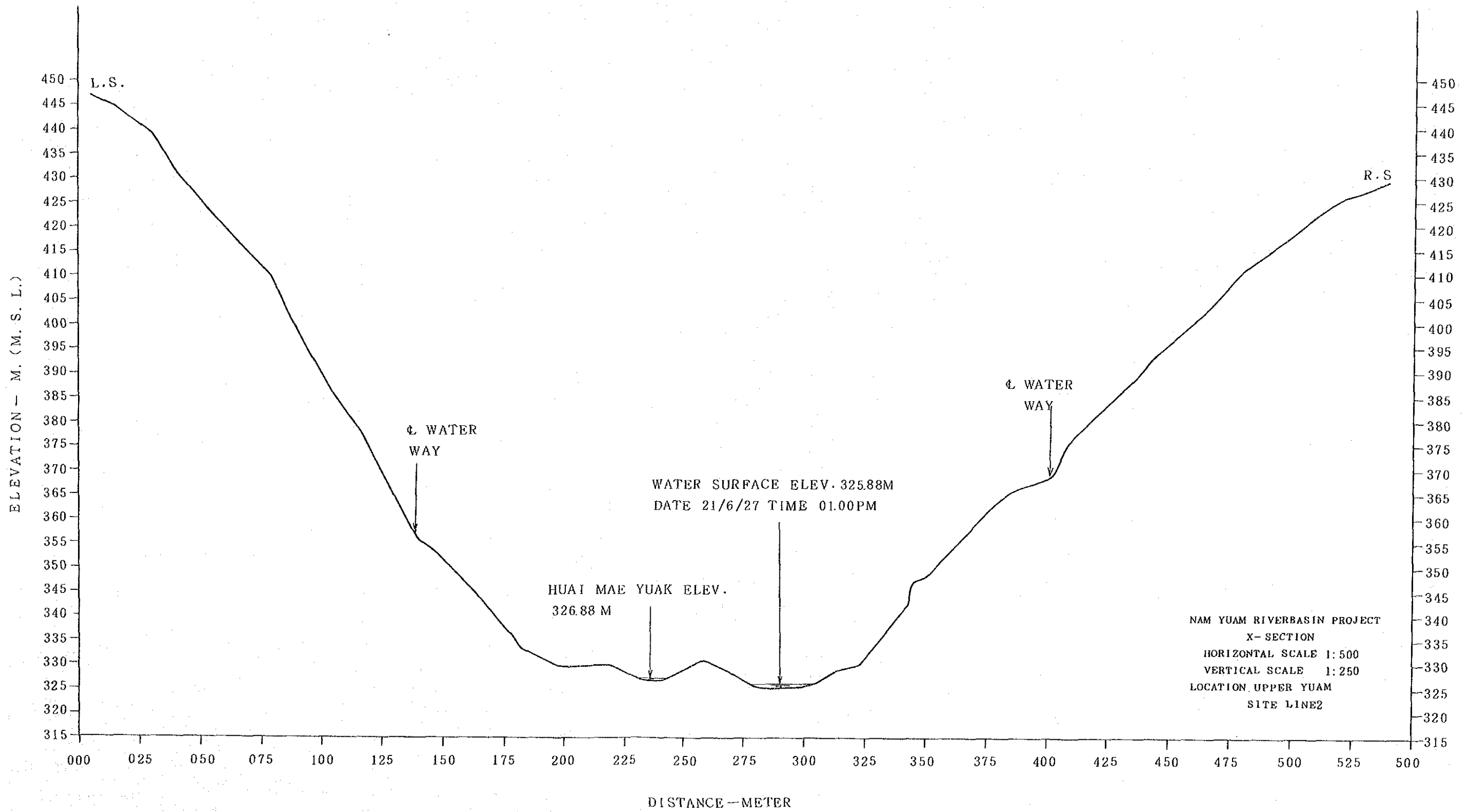
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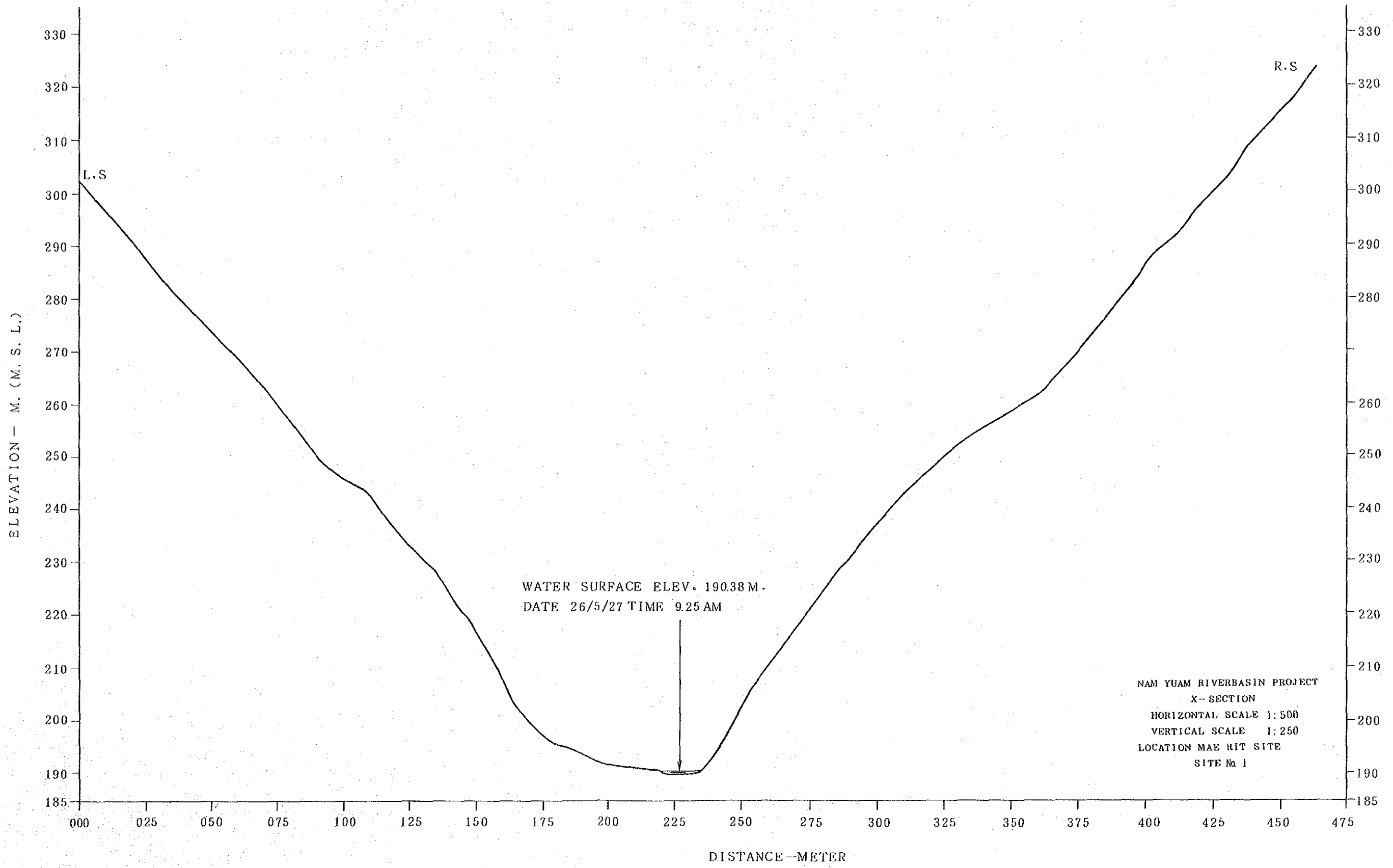
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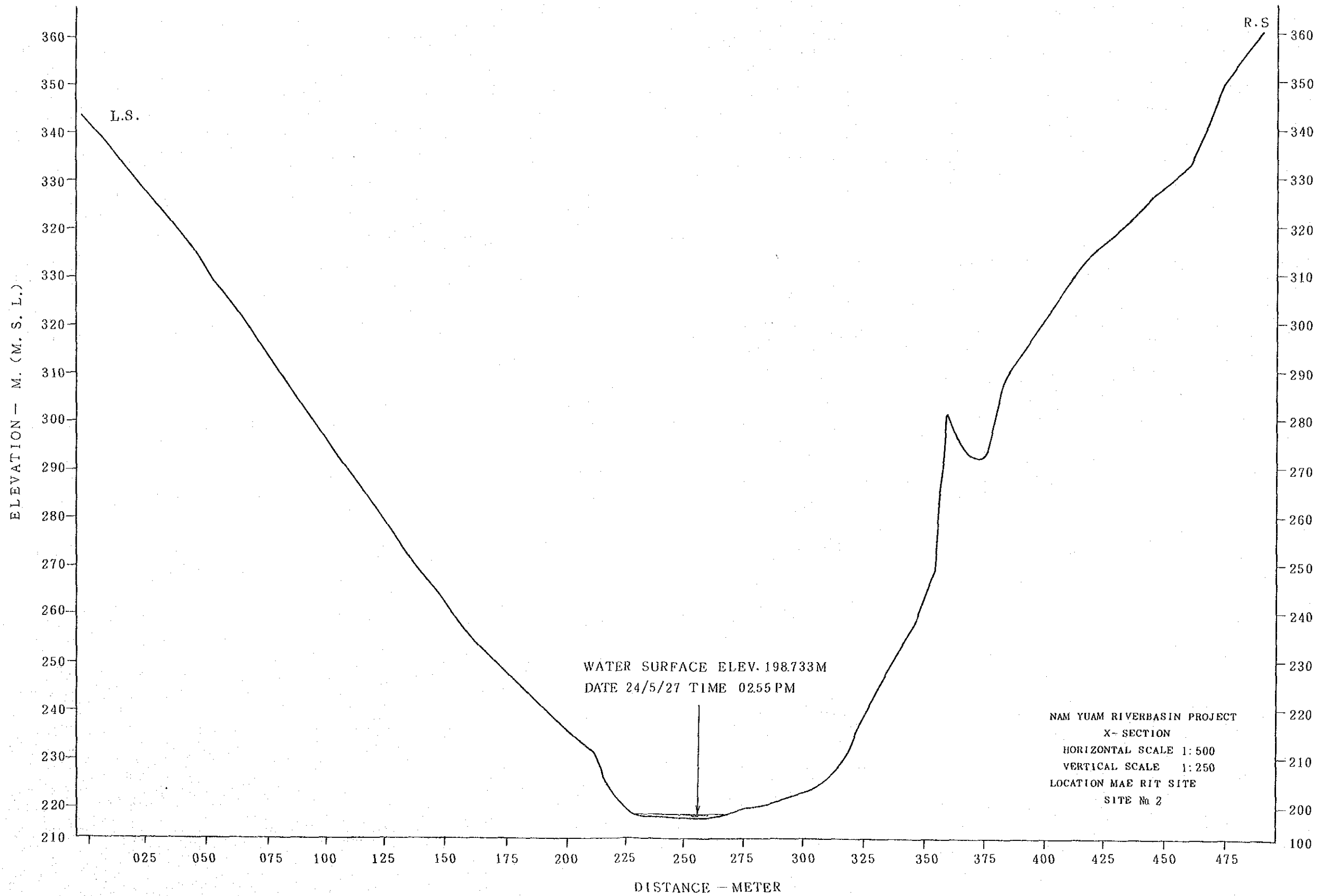
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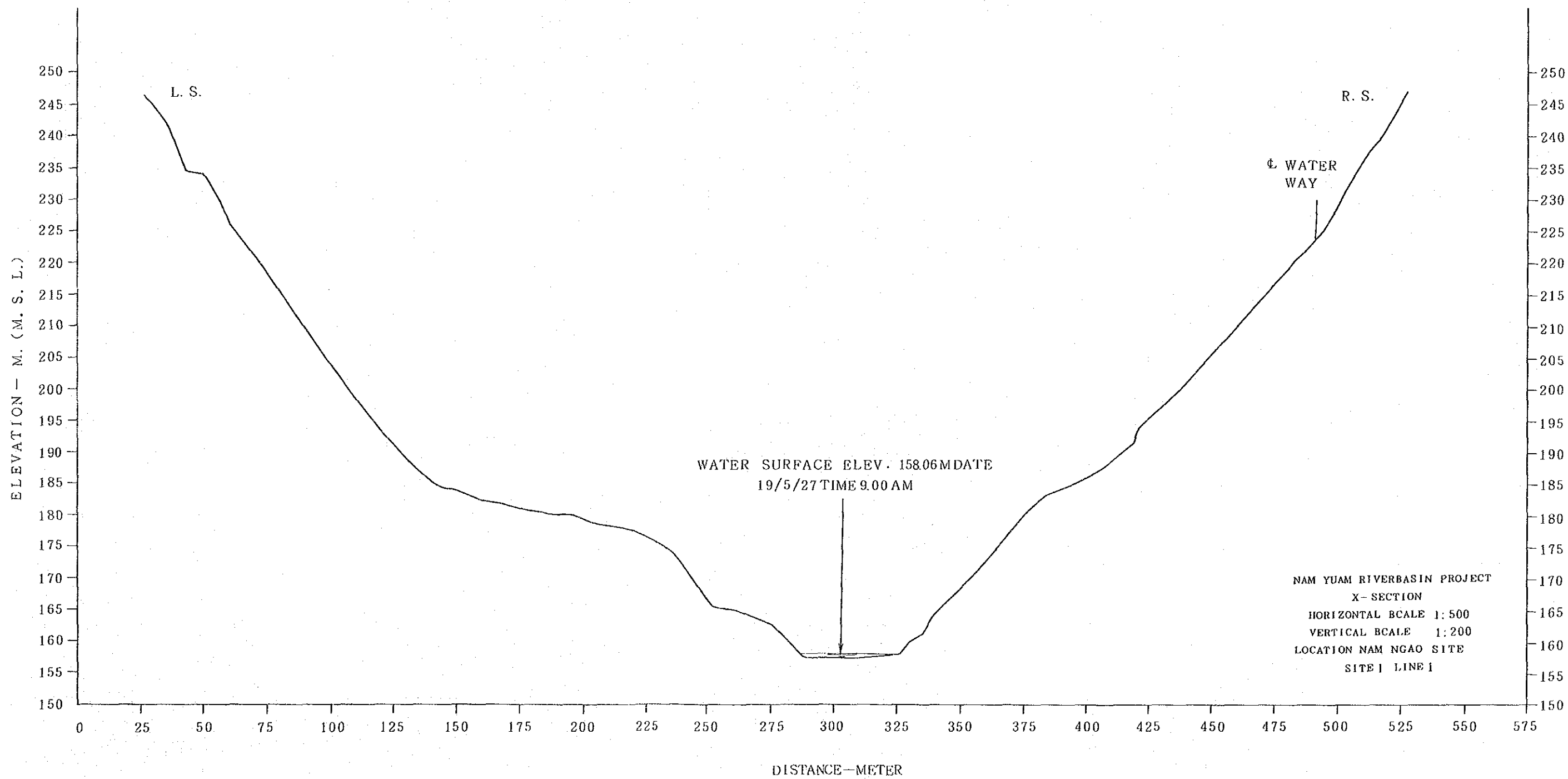


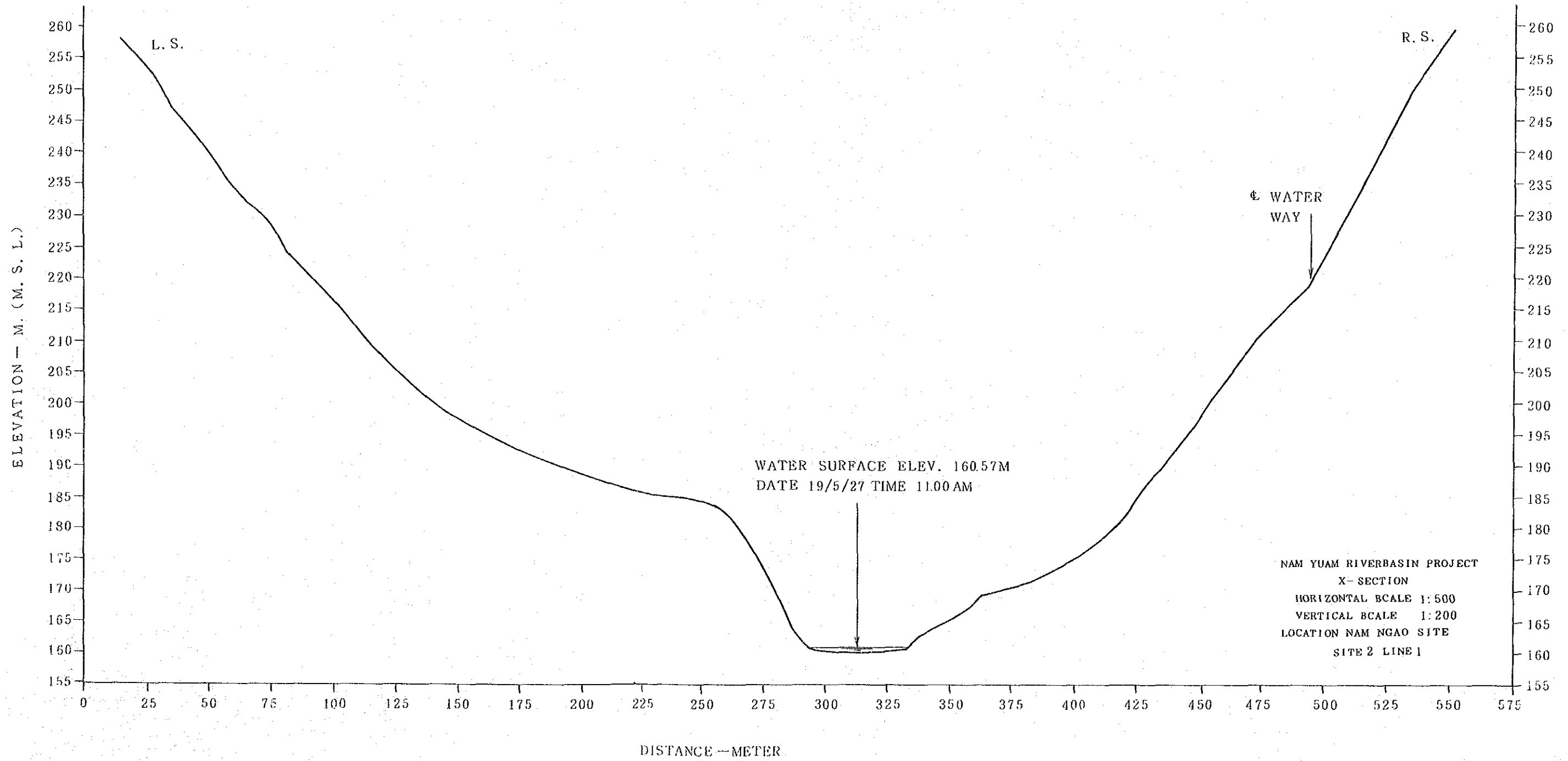




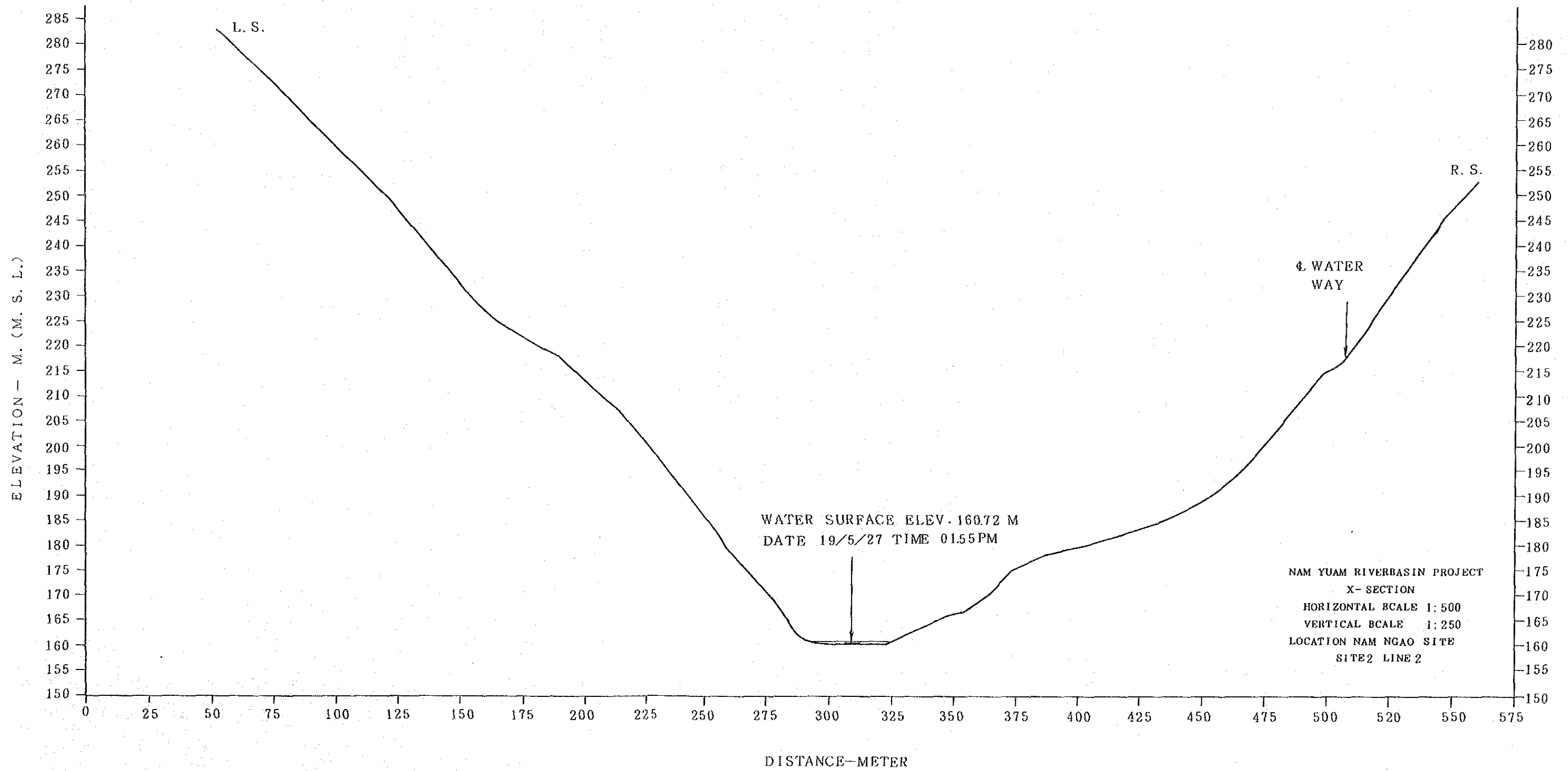








NAM YUAM RIVERBASIN PROJECT  
 X-SECTION  
 HORIZONTAL SCALE 1:500  
 VERTICAL SCALE 1:200  
 LOCATION NAM NGAO SITE  
 SITE 2 LINE 1



JICA