付－2 Terms of Reference (タイ側)

Project Title : Master Plans and Feasibility Studies of Water Supply Systems for Seven Provincial Towns. (Phuket, Prachatipat, Patum Thani, Takua Pa, Phang Nga, Thung Song and Su Ngai Golok)

Request Agency : Provincial Waterworks Authority (PWA), Ministry of Interior, Thailand

Proposed Source of Assistance : The Government of Japan

---

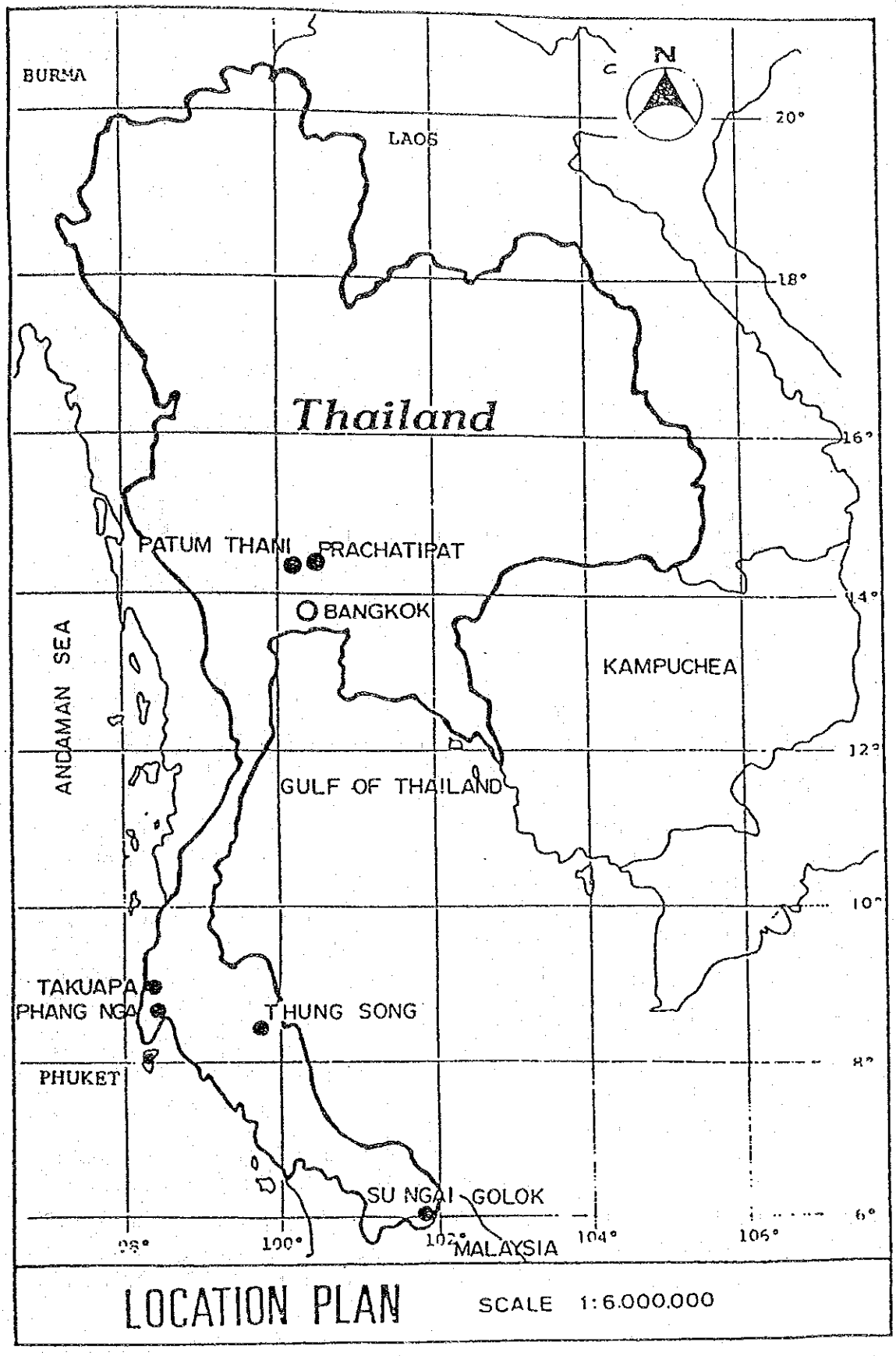
1. Background information and justification for the project

The Provincial Waterworks Authority (PWA) is a state enterprise supervised by the Board of Directors under the Ministry of Interior. PWA is responsible for the production and supply of drinking water to all people throughout Thailand, except Bangkok Metropolitan area, including 193 urban water supply schemes and 674 rural water supply schemes. There are 10 regional offices across the country that supervise the water supply systems on their operations and maintenance. Since insufficiency of clean water is still a major problem to the people in developing countries like Thailand, the Thai Government has been supporting PWA in providing clean and safe water to meet the customers' demand.

Phuket Waterworks is now under the responsibility of Phuket Municipality. Upon the Cabinet Resolution, all water supply systems operated by the Local Authorities (the Provincial Administrations, Municipalities and Sanitary Districts) have to be transferred to PWA. Meanwhile, PWA is constructing Phuket Water Supply System at Bang Waad Reservoir with the capacity of 1,000 m^3/hr to serve short-term demands at the deep sea port, tourist areas and nearby communities and also preparing to supply clean water to Phuket Municipality after the transfer. However, the Thai Government intends to develop Phuket Island as an international

tourism, industrial area and a growth pole city of the southern Region. Therefore, PWA has to prepare a long-rang comprehensive plan for supplying clean water to the entire island to meet the Government's objective.

Patum Thani, Prachatipat, Takua Pa, Phang Nga, Thung-song and Su Ngai Golok Waterworks are at present operating at their full capacities and cannot cover the expected future demands. In addition, the high percentage of leakage in the distribution networks and inadequacy of raw water sources are some of the critical problems both in terms of quality and quantity. Because of these deficiencies, these existing water supply systems need immediate improvements in order to cope with the future demands. These tasks will include long-range master plans and feasibility studies of these towns.


BURMA
LAOS
N
20°
18°
Thailand
16°
PATUM THANI
PRACHATIPAT
BANGKOK
14°
ANDAMAN SEA
KAMPUCHEA
12°
GULF OF THAILAND
10°
TAKUAPA
PHANG NGA
THUNG SONG
8°
PHUKET
SU NGAI GOLOK
6°
98°
100°
102°
MALAYSIA
104°
106°
LOCATION PLAN
SCALE 1:6.000.000

1.1 Geographical Background

a) Phuket

Phuket, the only island province of Thailand, is located in the southern region, on the west coast of Thailand with an area of 550 km^2, length of 44 km, and width of 18 km. It is noted for its large deposit of tin ore as well as for its touristic attractions. Apart from its rich natural resources Phuket is an island of beauty and charm with delightful beaches, mountains and waterfalls. (see Map I)

The population of Phuket Province in 1985 was approximately 145,229, of which 46,655 live in Phuket Municipality. The average annual growth rates in the past 5 years were 2.23 in Phuket Province and 0.66% in Phuket Municipality. The number of tourists coming to Phuket has rapidly increased over the past years and is expected to increase to 302,700 in 1987 and 479,300 in 1992, representing average growth of about 10% each year.

b) Patum Thani and Prachatipat

Patum Thani is the capital city of Patum Thani Province, located 28 km north of Bangkok, and Prachatipat is a town 11 km east of Patum Thani.

The population of Patum Thani in March 1984 was registered as 13,238 and that of Prachatipat 28,044. Their average annual growth rates in the past 10 years were 8.1% for Patum Thani and 4.5% for Prachatipat. These rates in the past two years accelerated to 8.7% and 10.4% respectively, and are expected to accelerate further in the coming years.

One principal factor supporting the rapid expansion of Patum Thani and Prachatipat is that a growing number of Bangkok workers began to settle in these fringe areas of Bangkok.

In view of the housing programs now vigorously developed in these areas, this trend of rapid expansion is expected to continue in the future. This phenomenon is particularly prevalent in Prachatipat which is located nearer to Bangkok.

Another factor supporting their expansion is the increasing number of manufacturing and chemical factories newly established in these areas. This may be partly due to economic reasons for selecting factory sites in the vicinity of Bangkok, the center of Thai economy, and partly due to their accessibility to the use of deep wells for their industrial water supply sources as such groundwater use is no longer permissable in Bangkok.

General predictions are that these two towns will soon constitute a combined Metropolitan fringe area which will be characterized both as a dormitory town and an industrial zone connected to Bangkok.

The area consists of a flat terrain whose service area covers 7.0 km^2. 2 meters above the sea level. The temperature ranges from 20°C to 35°C with an annual rainfall of 1,200 mm. The rainy season starts about May and the dry season from November. The geological characteristics of the surface soils are generally alluvial deposits of clay.

c) Takua Pa

Takua Pa is a municipality in Phang Nga Province located 710 km south of Bangkok and 130 km north of Phuket. Its population was registered at 9,222 in March, 1984, with an average annual growth rate of 0.44% far below the national population growth rate. Takua Pa is known as a town of tin mining, with the majority of its working population engaged in this industry.

Takua Pa consists of two parts (1) Ban Talad Takua Pa, an old village where mine workers originally assembled to constitute a community and (2) Ban Yan yao, a town newly built a decade ago by the Municipal Government which intended to absorb Ban Talad Takua Pa dwellers into this new town, as the Municipal authorities planned to develop tin mines in the village where rich tin mining beds were found. Despite the intention of the Municipal Government, however, the dwellers in Ban Talad Takua-Pa continued to stay and grow in numbers. Reflecting the

above-mentioned background. Ban Yan Yao is characterised as center of Governmental and other public organizations and commercial businesses, while Ban Talad Takua Pa is a residential town housing mostly miners' families.

The area consists of a flat terrain and the service area covers 3 km^2, 10 meters above the sea level. Its annual rainfall amounts to 3,000 mm, with the rainy season starting from May and the dry season from January. The geological characteristics of the surface soils are generally granite.

d) Phang Nga

Phang Nga Municipality is the center of Phang Nga Province, located about 795 km south of Bangkok and 86 km north of Phuket, the center of tourism in southern Thailand. Its population in March 1984 was 8,791 with an annual growth rate of 3%, considerably higher than the national level. The main industry of the town is tin mining. The town also serves as a commercial center for surrounding villages and because of its beautiful mountaneous and bayside scenery, and being designated as a national park, tourism is a potentially important industry. With a number of governmental institutions located in its center, the town constitutes a core of Phang Nga Province and is 6.75 km^2 in size.

The area consists of a flat terrain stretching along the Phang Nga River, with the service area covering 1.1 km^2, 5-10 m above the sea level. Its annual rainfall amounts to 2,000 mm, with the rainy season starting from May and the dry season from January.

e) Thung Song

Thung Song is a municipality in Nakhon Srithammarat Province, located approximately 710 km south-west of Bangkok and 170 km north-west of Had Yai. Na Bon is a small neighbouring community with a populaion of 4,890. It is located 14 km north-west of Thung Song, shares the same water supply system with Thung Song and is known as a rubber industry town having a

railway station in its center. Thung song is a commercial center for the vicinity area consisting mostly of rubber plantations and rice fields. The municipality is also a center for government institutions, and schools. The water consumption of these institutional users amounts to 45% of the total water sales of Thung Song Waterworks. Thung Song's population in 1984 was 24,558, with a recent average annual growth rate of 1.4%. In Na Bon the growth rate is higher at 1.8%.

The area consists of a flat terrain with a service area covering 2.5 km^2, 50 m above the sea level. Its annual rainfall amounts to 1,800 mm, with the rainy season starting from May and the dry season from January.

f) Su Ngai Golok

Su Ngai Golok is a municipality in Narathiwat Province located 1,240 km south of Bangkok on the River Golok which is the border between Thailand and Malaysia. Its population in 1984 was 25,221 with a recent average annual growth rate of 3.3%.

Su Ngai Golok is known as a town of tourism, mostly frequented by Malaysian visitors. Though the town is no more than 2 sq kilometers wide, the number of hotels exceeds 40. Restaurants and shops also abound in the center of the town. Outside the center, however, the town has a rural appearance, with no important industry except some small scale lumber factories.

The area consists of a flat terrain with a service area covering 2 km^2, 20 m above the sea level. Its annual rainfall amounts to 1,000 mm, with the rainy season starting from May and the dry season from January.

1.2 Existing Water Supply Systems Situations

a) Phuket Waterworks

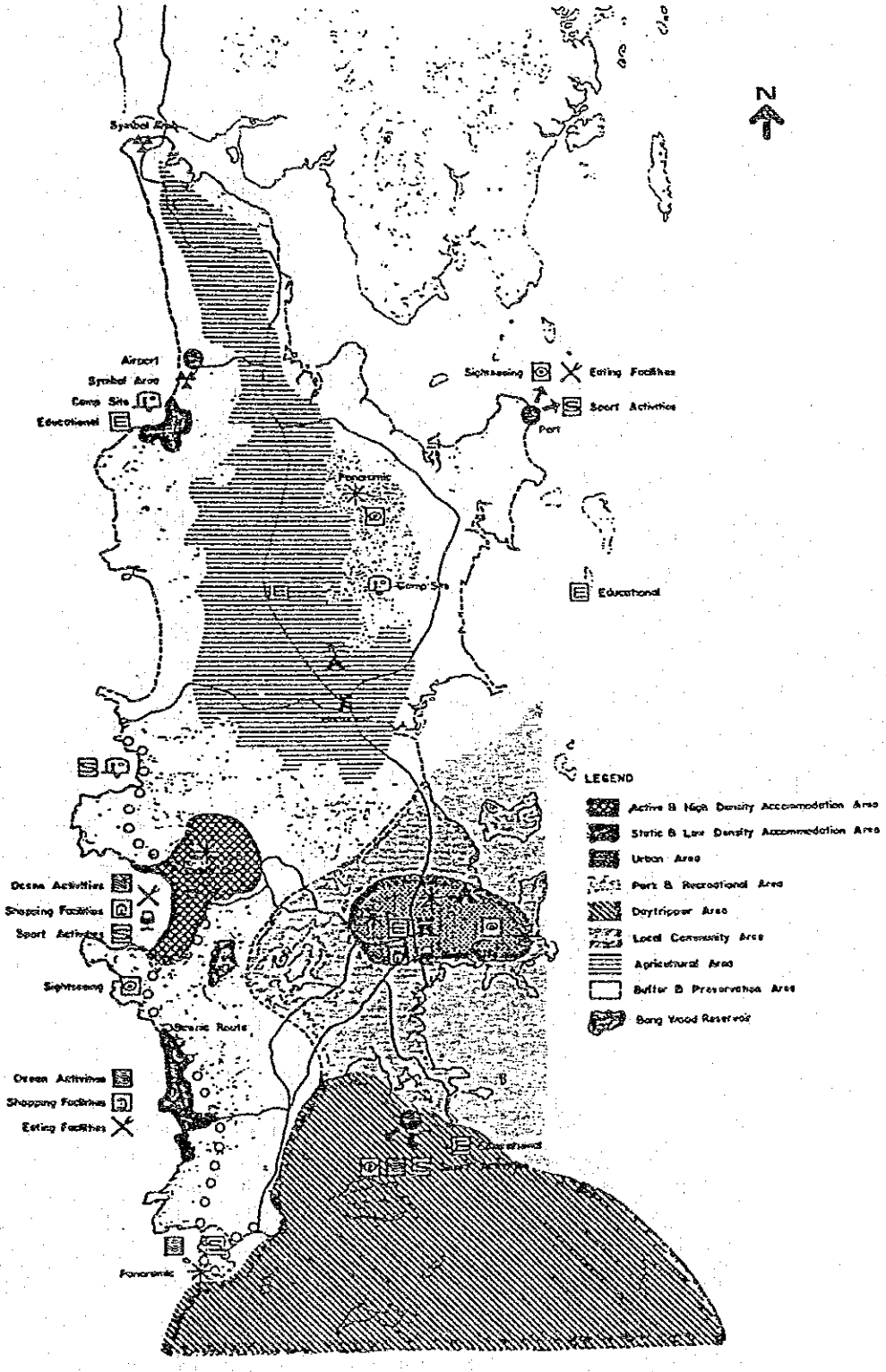
As mentioned before, Phuket Waterworks is now under the responsibility of Phuket Municipality and will be transferred to PWA in the near future. Phuket Waterworks started operation in 1957 with the capacity of 40 m^3/hr. and is now collecting raw water from mining pits. The water supply system was expanded in 1964 and 1975 with the capacities of 40 m^3/hr and 250 m^3/hr respectively.

In 1985, PWA started construction of a new water treatment plant at Bang Waad Reservoir with the capacity of 1,000 m^3/hr using raw water from the Reservoir. The new plant will supply water to Patong Sanitary District, Kathu Sanitary District, the deep sea port and to Phuket Municipality after transferring of Phuket Municipality Water Supply System (see Map II).

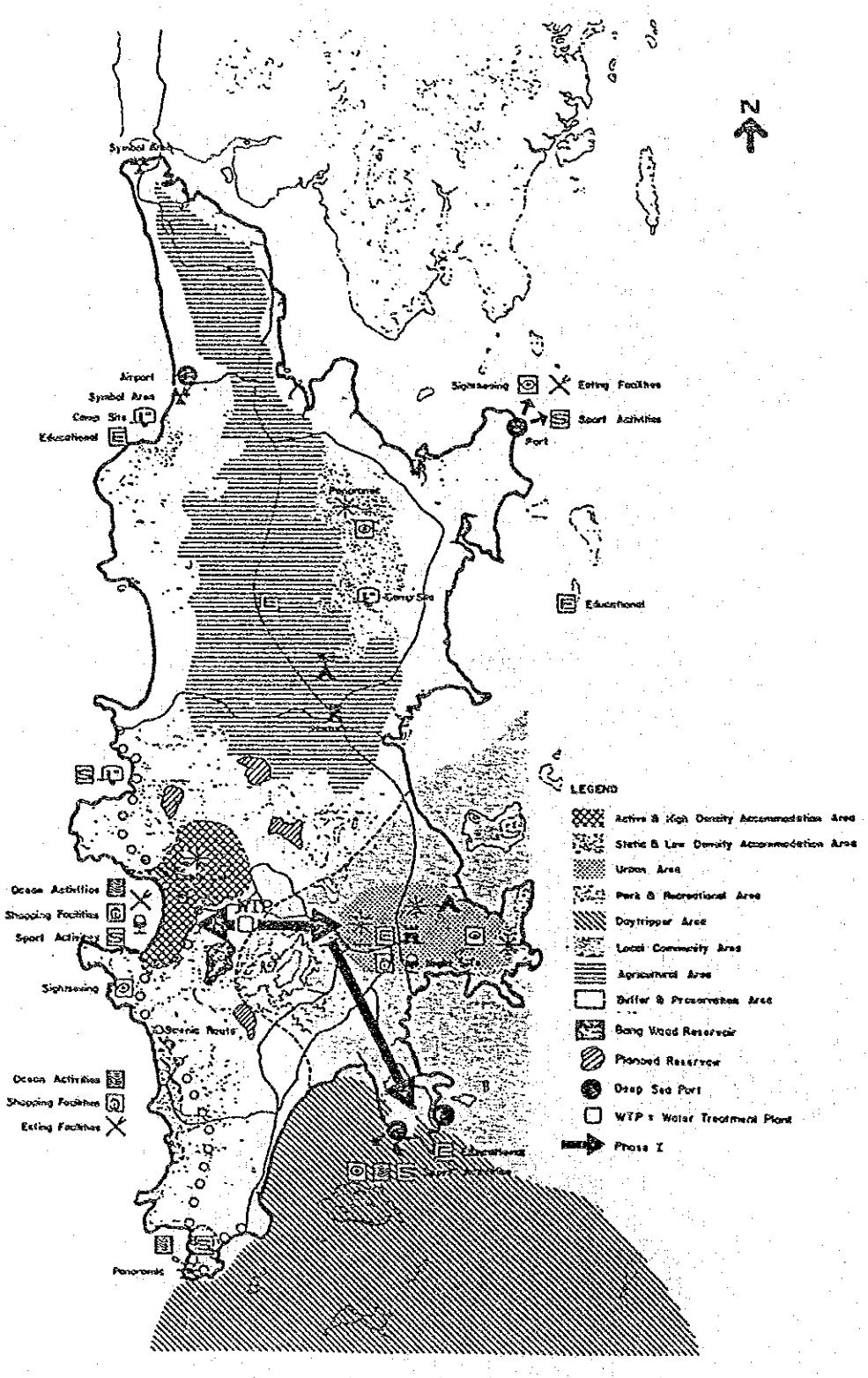
a) Patum Thani Waterworks

Patum Thani Waterworks started operation in 1959 with two deep wells (40 m^3/hour each). In 1979 the first expansion work with an additional two deep wells (60 m^3/hour each) was carried out. The deep well water is supplied to consumers after chlorination through either an elevated tank or by direct pumping.

MAP I


N
Airport
Symbol Area
Camp Site
Educational
Sightseeing
Eating Facilities
Sport Activities
Port
Panoramic
Camp Site
Educational
Ocean Activities
Shopping Facilities
Sport Activities
Sightseeing
Scenic Route
Ocean Activities
Shopping Facilities
Eating Facilities
Panoramic
LEGEND
Active & High Density Accommodation Area
Static & Low Density Accommodation Area
Urban Area
Park & Recreational Area
Daytripper Area
Local Community Area
Agricultural Area
Buffer & Preservation Area
Bang Wood Reservoir

MAP II



PHUKET WATER SUPPLY PROJECT PHASE 1

Table I : Basic Figures of Phuket Water Supply System (1984)

Phuket Municipality Water Supply System		
- Water sources	:	Mining Pits
- Treatment	:	Sedimentation and rapid sand filter
- Production Capacity	:	330 m^3/hr.
- Population in service area	:	46,659
- Population served	:	27,700 (59%)
- Number of connections	:	4,618
Phuket Water Supply System (PWA system, under construction)		
- Water sources	:	Bang Waad Reservoir
- Treatment	:	Sedimentation and rapid sand filter
- Production Capacity	:	1,000 m^3/hr.
- Service area	:	Patong Sanitary District, Kathu Sanitary District and deep sea port.

Table II : Basic Figures of Patum Thani Waterworks (1984)		
- water source	:	Two groundwater stations
- Treatment	:	Chlorination only
- Production capacity	:	100 m^3/hour (2,400 m^3/day)
- Service area (Figure 1)	:	Patum Thani municipality (2.5 km^2)
- Total population	:	13,238
- Served population	:	6,400 (48.3%)
- Number of connections	:	1,066
- Water production	:	982,848 m^3/year
- Water sale	:	468,692 m^3/year (47.7%)
- Number of Waterworks staff	:	17

Major Facilities :		
- Deep wells	:	40 m^3/hour x 2 units and 60 m^3/hour x 2 units
- Intake pumps	:	60 m^3/hour x 2 units 40 m^3/hour x 1 unit
- Clear water reservoirs	:	Ground-level type. 200 m^3 and 500 m^3
- Distribution pumps	:	90 m^3/hour x 3 units
- Elevated tank	:	50 m^3
- Distribution pipelines	:	250 mm and below. Asbestos cement pipes. L = 25.0 km

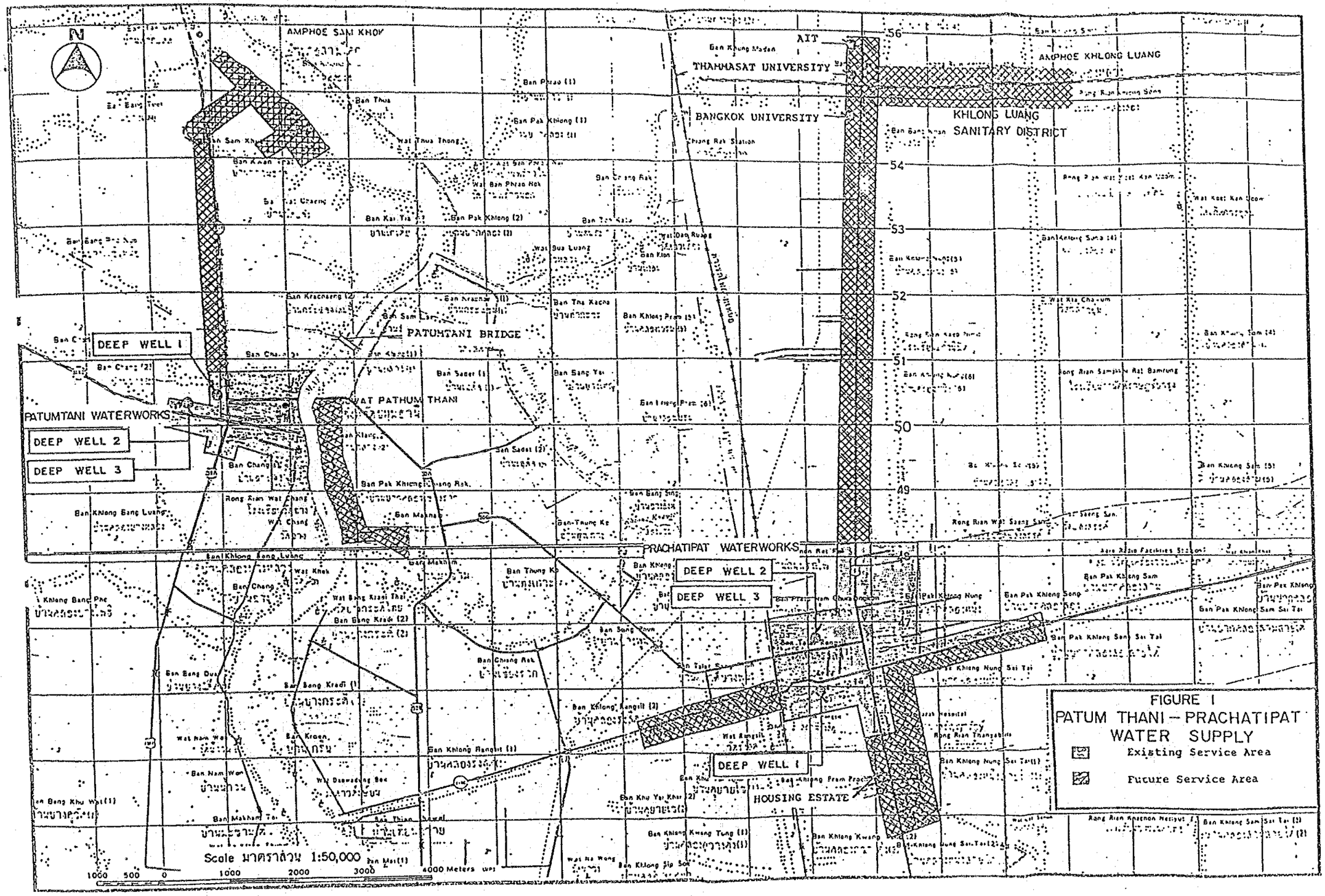
c) Prachatipat Waterworks

Table III : Basic Figures of Prachatipat Waterworks (1984)

- Water source	:	Deep well groundwater
- Treatment	:	Chlorination only
- Production capacity	:	120 m^3/hour (2,880 m^3/d)
- Service area (Figure 1)	:	Prachatipat municipality (4.5 km^2)
- Total population	:	28,044
- Served population	:	6,730 (24.0%)
- Number of connections	:	1,121
- Water production	:	583,245 m^3/year
- Water Sale	:	356,865 m^3/year (61.1%)
- Number of Waterworks staff	:	15

Major Facilities :

- Deep wells	:	2 deep wells x 120 m^3/hour each
- Intake pumps	:	110 m^3/hour x 93 m x 2 units
- Clear water reservoir	:	Ground-level type, 2,000 m^3
- Distribution pumps	:	150 m^3/hour x 35 m x 3 units (including one unit of diesel pump)
- Elevated tank	:	250 m^3
- Distribution pipelines	:	400 mm/300 mm/200 mm/100 mm Asbestos cement pipe. L = 11.0 km


N
AMPHOE SAM KHOK
AIT
THAMMASAT UNIVERSITY
BANGKOK UNIVERSITY
AMPHOE KHLONG LUANG
KHLONG LUANG
SANITARY DISTRICT
PATUMTANI BRIDGE
WAT PATHUM THANI
DEEP WELL 1
PATUMTANI WATERWORKS
DEEP WELL 2
DEEP WELL 3
PRACHATIPAT WATERWORKS
DEEP WELL 2
DEEP WELL 3
DEEP WELL 1
HOUSING ESTATE
56
55
54
53
52
51
50
49
Scale มาตราส่วน 1:50,000
1000 500 0 1000 2000 3000 4000 Meters
FIGURE 1
PATUM THANI – PRACHATIPAT
WATER SUPPLY
Existing Service Area
Future Service Area

d) Takua Pa Waterworks

Table IV : Basic Figures of Takua Pa Waterworks (1984)

- Water source	:	Bang Ee waterfall and Khum Muang abandoned-tin-mining-pit reservoir
- Treatment	;	Chlorination only to Bang Ee waterfall water and rapid sand filtration to the reservoir water
- Production capacity	:	50 m^3/hour (1,200 m^3/day)
- Service area (Figure 2)	:	Ban Yan Yao and Ban Talad Takua Pa (3.0 km^2)
- Total population	:	9,222
- Served population	:	5,800 (62.9%)
- Number of connections	;	967
- Water production	:	443,830 m^3/year
- Water sale	;	304,755 m^3/year (68.7%)
- Number of waterworks staff	:	15

Major Facilities :

- Intake main from Ban Ee waterfall to grit chamber (ø 150 mm ACP x 400 m)
- Grit chamber for Ban Ee waterfall water
- Raw water pumps for Khum Muang abandoned-tin-mining-pit reservoir (100 m^3/h x 30 m)
- Raw water main to treatment plant
- Treatment facilities of 40 m^3/h, consisting of coagulation, sedimentation, filtration and chlorination
- Clear water reservoir, ground-level type
- High lift pumps (120 m^3/h x 30 m)
- Elevated tank (120 m^3)
- Distribution pipelines :

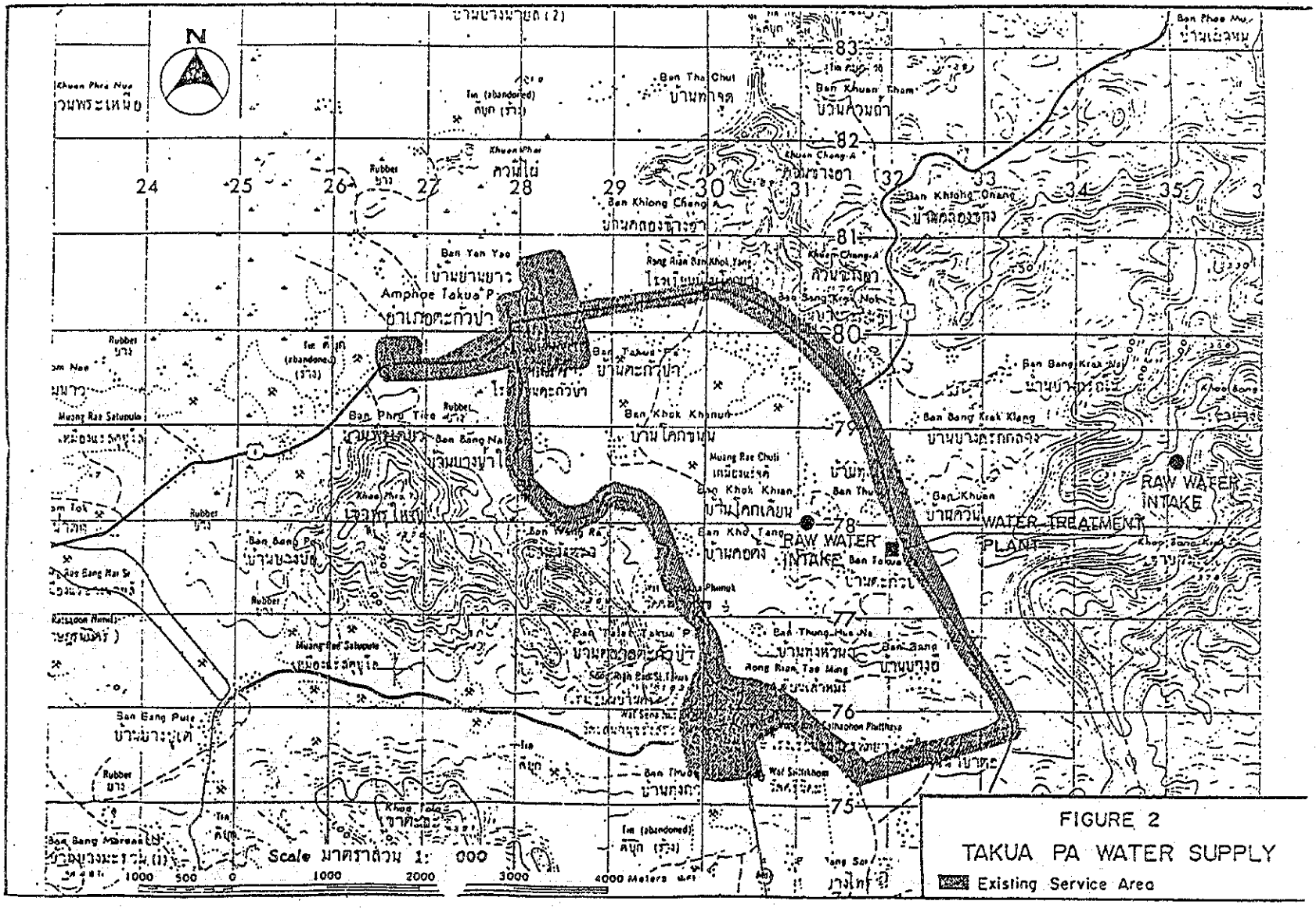


FIGURE 2

TAKUA PA WATER SUPPLY

Existing Service Area

250 mm ACP - - - - -	8,900 m
200 mm ACP - - - - -	7,150 m
150 mm ACP - - - - -	3,500 m
100 mm ACP - - - - -	3,200 m
Total - - - - -	22,750 m

e) Phang Nga Waterworks

Phang Nga Waterworks was founded in 1963 with the capacity of 20 m^3/hour treatment of river water flowing in the Phang Nga municipality. In 1969, the first expansion work was executed with additional treatment facilities having a capacity of 40 m^3/hour : water source was obtained from the Pak Ton waterfall located far from the populated area; and the former intake facility on the river was abandoned because the raw water became muddy with very fine particles of clay. As a result of an expansion in tourism, the Waterworks has recently started to supply water to those hotels located outside the boundary of the municipality.

Table IV : Basic Figures of Phang Nga Waterworks (1984)

- Water source	:	Pak Ton Waterfall
- Treatment	:	Rapid sand filtration
- Production capacity	:	60 m^3/hour (1,400 m^3/day)
- Service area (Figure 3)	:	Phang Nga (1.1 km^2)
- Total population	:	8,791
- Served population	:	5,670 (64.5%)
- Number of connections	:	945
- Water production	:	394,210 m^3/year
- Water sale	:	283,152 m^3/year
- Number of Waterworks staff	:	17

Major Facilities :

- Raw water main (250 mm x 3,600 m), from Pak Ton waterfall to Treatment Plant.
- Treatment facilities of 20 m^3/hour and 40 m^3/hour, both consisting of coagulation, sedimentation filtration and chlorination.
- Clear water reservoir, ground-level type, 500 m^3
- High lift pumps
- Elevated tank (50 m^3)
- Distribution pipelines :

200 mm ACP - - - - -	8,100 m
150 mm ACP - - - - -	10,500 m
100 mm ACP - - - - -	4,680 m
Total - - - - -	23,280 m

(In addition, 150 mm ACP x 6,500 m was recently installed to the hotel)

f) Thung Song Waterworks

Thung Song Waterworks was originally constructed in 1961 with a 40 m^3/hour treatment plant, taking raw water from a canal in Thung Song. In 1969, a new treatment plant with the capacity of 160 m^3/hour was constructed, taking river water from the Khlong Tha Phae which originates in the Young Waterfall; and the former plant was abandoned due to the deterioration of raw water quality.

Table V : Basic Figures of Thung Song Waterworks (1984)

- Water source	:	River Khlong Tha Phae, coming from Yong Waterfall
- Treatment	;	Rapid sand filtration
- Production capacity	:	160 m^3/hour (3,480 m^3/day)
- Service area (Figure 4)	:	Thung Song municipality and Na Bon community (2.5 km^2)
- Total population	:	21,137 (Thung Song) + 3,421 (Na Bon) = 24,558
- Served population	:	17,880 (Thung Song) + 1,800 (Na Bon) = 19,680 (80.1%)
- Number of connections	:	3,280
- Water production	:	1,773,604 m^3/year
- Water sale	:	1,396,936 m^3/year (78.8%)
- Number of Waterworks staff	:	24

Main Facilities :

- Water intake facility (3 x 250 mm steel pipes)
- Intake pumps (180 m^3/hour x 14 m x 3 units)
- Treatment facilities of 160 m^3/hour, consisting of coagulation, sedimentation, filtration and chlorination
- Clear water reservoir, ground-level type, 1,000 m^3
- High lift pumps (200 m^3/hour x 30 m x 2 units)
- Elevated tank (250 m^3)
- Booster pumping station to Ban Na Bon, with a reservoir
- Distribution pipelines

300 mm ACP	- - - -	4,700 m
250 mm ACP	- - - -	120 m
200 mm ACP	- - - -	2,450 m
150 mm ACP	- - - -	7,220 m
100 mm ACP	- - - -	3,860 m
Total	- - - -	18,350 m

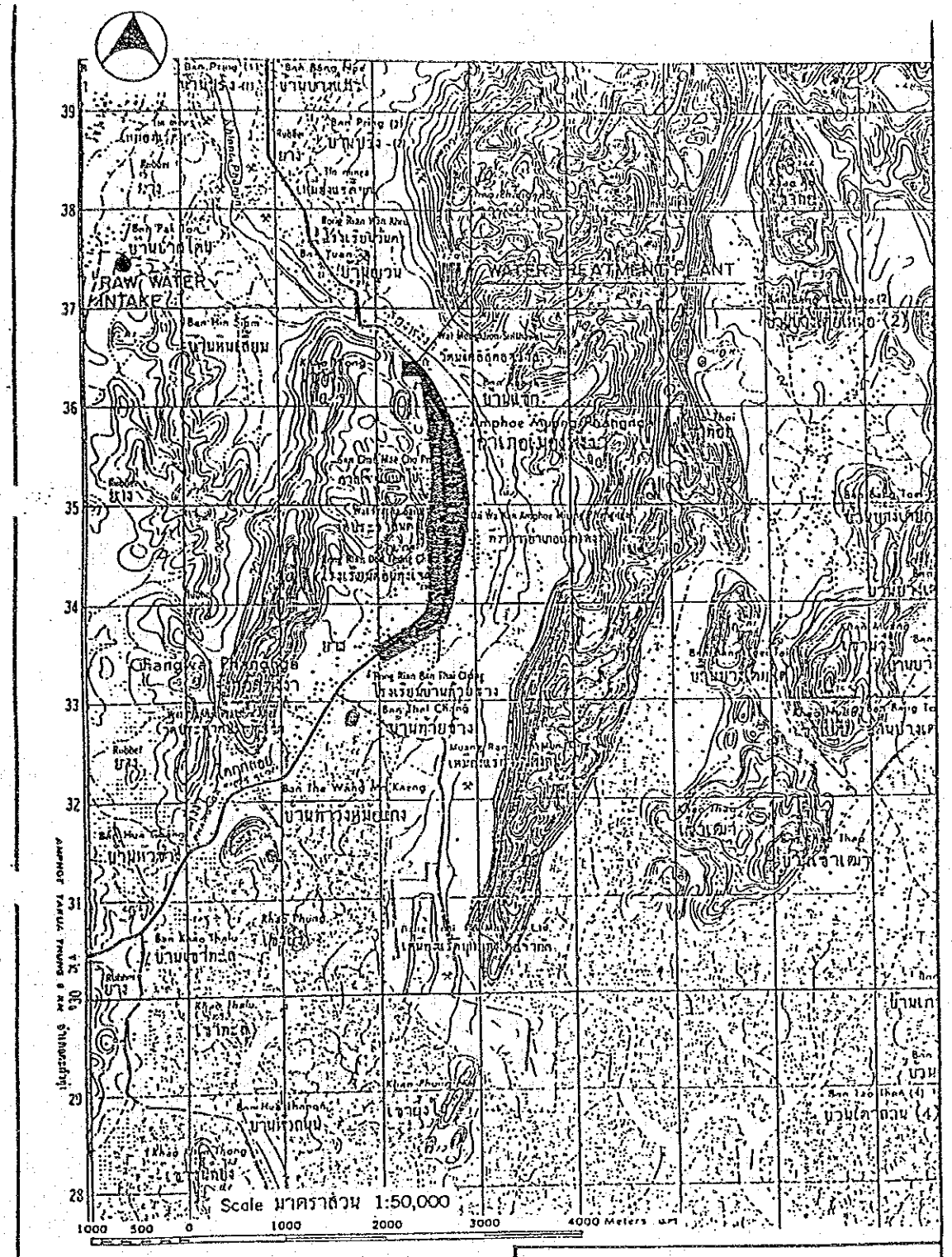


FIGURE 3

PHANG NGA WATER SUPPLY

Existing Service Area

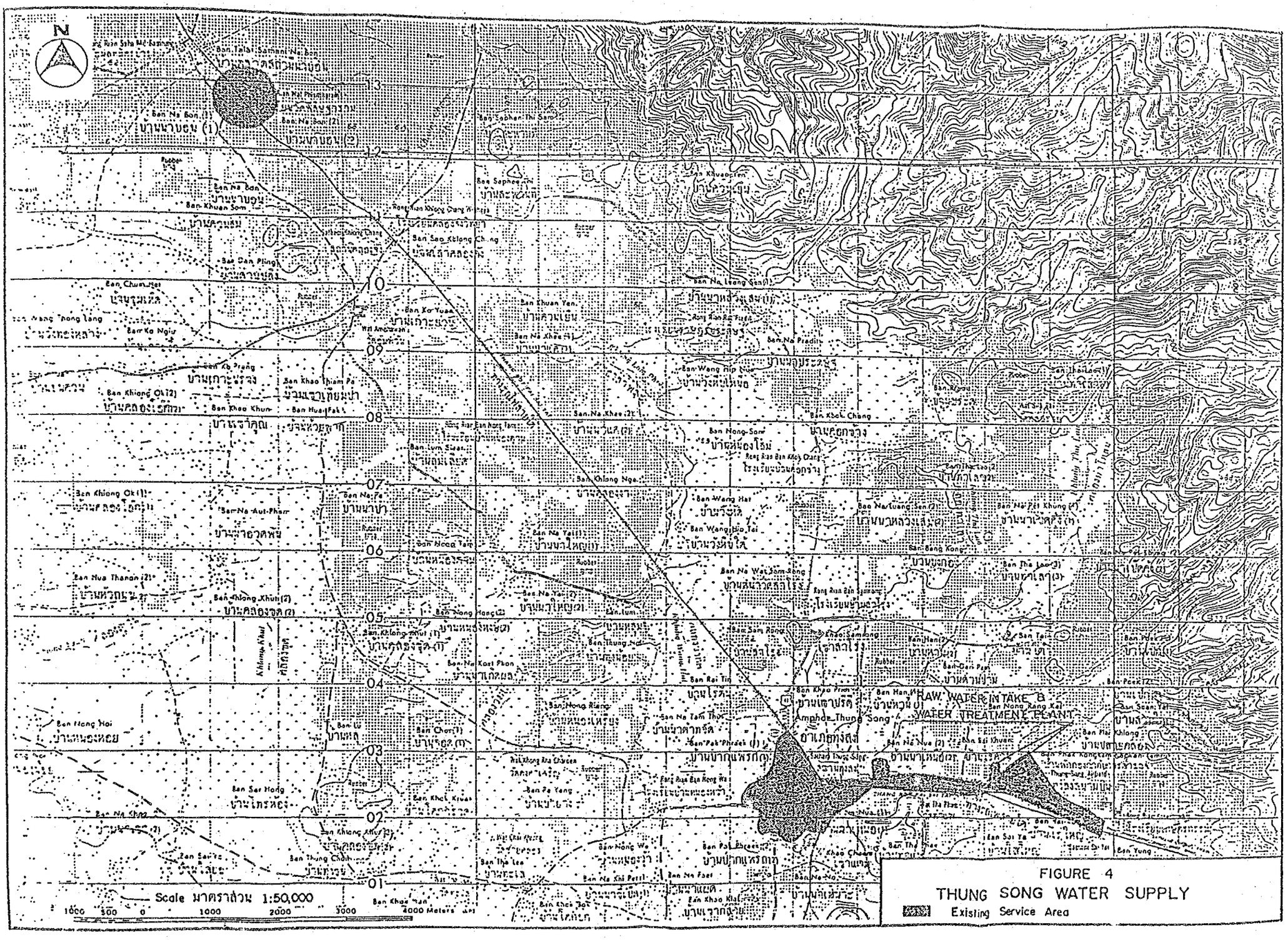


FIGURE 4

THUNG SONG WATER SUPPLY

Existing Service Area

f) Su Ngai Golok Waterworks

Su Ngai Golok Waterworks was founded in 1964 with a treatment capacity of 20 m^3/hour, taking raw water from River Golok, with its intake site at the town area, and it was expanded in 1970 by an additional capacity of 160 m^3/hour from the same water source, making a total of 180 m^3/hour.

Table VI : Basic Figures of Su Ngai Golok Waterworks (1984)

- Water source	:	River Golok
- Treatment	:	Rapid sand filtration
- Production capacity	:	180 m^3/hour (4,320 m^3/day)
- Service area (Figure 5)	:	Su Ngai Golok municipality (2.0 km^2)
- Total population	:	25,221
- Served population	:	12,430 (49.3%)
- Number of connections	:	2,072
- Water production	:	1,613,456 m^3/year
- Water sale	;	1,071,329 m^3/year
- Number of Waterworks staff	;	19

Major Facilities :

- Water intake (3-250 mm steel pipes)
- Intake pumps (160 m^3/h x 20 m x 1 unit, 200 m^3/h x 25 m x 1 unit, and standby generator of 160 m^3/h x 20 m).
- Treatment facilities of 20 m^3/h and 160 m^3/h, both consisting of coagulation, sedimentation, filtration and chlorination.
- Clear water reservoirs, ground-level type
- High lift pumps
- Elevated tanks (50 m^3 + 250 m^3 = 300 m^3)
- Distribution pipelines :

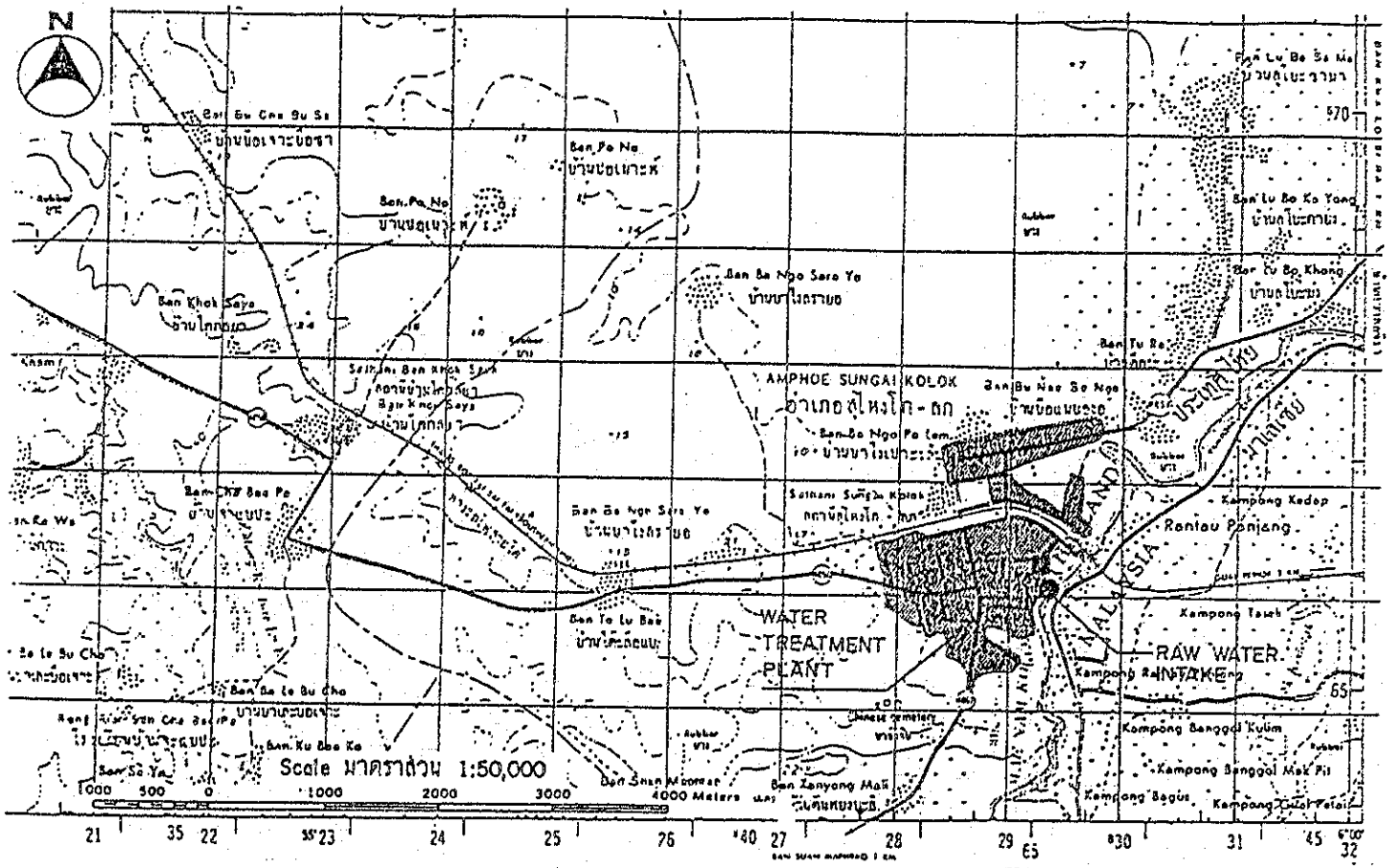


FIGURE 5

SU NGAI GOLOK WATER SUPPLY

Existing Service Area

250 mm	1,495 m
200 mm	2,100 m
150 mm	2,800 m
100 mm	7,800 m
Total	14,195 m

(Note) All pipes are of asbestos cement (ACP) : old pipes (1964) all AC Class 15 and new pipes (1970) are AC Class 20.

2. Details of the project

2.1 Program goal

The Thai Government has adopted the target of the International Drinking Water Supply and Sanitation Decade and set its long range goal to supply 90% of the entire population with clean and drinkable water by the end of the Decade.

PWA s responsibility is to provide adequate clean water for the towns in order to raise the standard of living of the people and to promote activities of the towns. Nowadays, the limited capacity of water supply expansion and raw water sources are the main problems to improve PWA waterworks. Therefore, immediate improvement of six municipalities are urgently needed.

2.2 Project objective

It is the objective of this Project to improve the water resources condition and to plan for the extension of the existing water supply systems in order to cope with the future demands. These tasks will include long term master plans and feasibility studies for each town.

A long term master plan for each area will be prepared up to the year 2011. The master plan shall involve the careful study of alternative development programmes including water sources.

Also, a feasibility study for the first 15 years (2001) of each area is based on the master plan and shall involve preliminary design, cost estimates, financial analyses, economic justification and proposed organization of the waterworks system.

2.3 Conditions expected at completion of the project

Master Plans and Feasibility Studies Reports are expected upon the completion of the Project. Furthermore, the expected benefits and outputs are forecasted as follows :

Outputs

- expansion of the capacity of the existing waterworks
- overall improvements of the existing systems
- reduction of the unaccounted-for water
- improvements and expansion of the existing distribution networks
- strengthening of the operation and maintenance procedures, and training of PWA staff.

Expected benefits

- safe water supply for more than 90% of the city's population and, therefore, improvement of the public health in the service areas.
- possible faster economic growth for these provinces
- improved operation and maintenance performance of PWA personnel through training for operators and planning staff.

2.4 Recommended sources of information and data related to the project, necessary for project verification

Data and information related to the Project are to be provided by the Provincial Waterworks Authority and ECFA

(Engineering Consulting Firms Association of Japan) Mission Team who had conducted and surveyed six water supply systems. (Prachatipat, Patum Thani, Takua Pa, Phang Nga, Thung Song and Su Ngai Golok)

2.5 Duration of the Project

The tentative schedule for the Project is expected to start in June 1986 - March 1987. (10 months)

2.6 Project site

An office will be provided in Bangkok at PWA's Headquarters. The adequate field offices will also be provided in seven municipalities.

2.7 Project work plan and activities

2.7.1 Detailed work plan/project activities and scope of work

A long term master plan for each area will be prepared up to the year 2011 and also the feasibility study of each area also will be prepared, based on the master plan.

Master Plan

1. evaluate all available data such as maps, geological, hydrological and climatological reports, census statistics, water production and demand, etc. Research and develop such other data and information as required to support the project analysis.
2. provide a detailed description of the existing water supply system, preparing an inventory list of each existing system including an evaluation which will show what is to be integrated into the future designed water system.
3. prepare the preliminary design of the facilities for immediate improvement of the existing water supply system including increase of supply quantity within present

area served and its contiguous area if necessary.

4. make hydrogeological and hydrological studies to determine the availability of water resources and prepare a development plan to meet present and future water demands.

5. conduct field surveys and make studies on population, socio-economics, locations of facilities, water production and consumption, power capacity and requirements, availability of local construction materials and equipment and effects of the project on the environment.

6. analyze the results of field studies and the water quality of various alternative sources.

7. delineate the service areas for each bench-mark year, carefully evaluating future development of the study area, estimating population increases and considering future land use.

8. estimate population in each area served, and water demands (average day, maximum day and peak hour) for each bench-mark year.

9. provide the proposed phasing of the project up to the year 2011 and illustrate the proposed water supply system of each phase.

10. ascertain the existing amounts of unaccounted-for -water broken down into the respective components of wastage, illegal use and leakage from the system.

11. describe the present water uses of each area and evaluate the benefits of the proposed water supply system on future water uses.

Feasibility Study

1. develop alternative plans for supply, treatment, transmission and distribution of water for the first phase project. (2001)

2. select a plan, based on the least present cost, taking into consideration capital cost and annual operating and maintenance costs.

3. make preliminary engineering plans which are sufficiently accurate and complete to indicate the location, arrangement, elevation and principal features of the project, which serve as the basis for sound cost estimates, including drawings, design criteria and analysis, all sufficiently detailed to define the project.

4. prepare cost estimates for the engineering, construction, operation and maintenance of the project recommended for the first phase. Each of the cost items shall be defined in terms of local and foreign exchanges. Total costs estimated shall be the summation of the unit costs of the works including a bill of quantities and unit prices which consist of materials, equipment and labor costs or other bases used for estimating.

5. determine the community's willingness-to-pay in terms of water rates.

6. develop a financial plan based on the required investment of the recommended project indicating source of funds and the timing of the investments. Carry out a detailed analysis of the existing and projected financial operation including yearly estimate of revenue, operating expenditures, borrowing, capital investment, etc., and the effects of the expected price escalation and water rate increases.

7. provide economic justification for the net benefits and costs. Costs shall be converted to economic cost to reflect alternative uses of resources by the nation and benefits shall include effects of the project on water

users and the national interest extended beyond local bounds.

2.7.2 Time schedule of project activities

Time Schedule

Activities	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Master Plan												
Feasibility Study												

3. Details of the implementing / operating agency

3.1 Institutional Frameworks

The Provincial Waterworks Authority operates and maintains the water supply schemes, whereas the sanitation services are provided by the municipality under the supervision of the Public Works Department. PWA will contribute to the studies through counterpart personnel consisting of engineers, socio-economist, and financial analyst and some secretariat's office support.

3.2 PWA staff/personnel participating in project implementation

a) Project Manager

A highly qualified PWA staff will be assigned to oversee the execution of the Project. He will also be responsible for the progress and results of the investigation of the studies in each phase.

b) Water Supply / Water Resources Engineers

The highly qualified persons who has extensive experiences in the field of water supply and water resources and have been involved in international works.

c) Water Treatment Expert

A highly qualified person who has experiences in chemistry. water analysis. To be responsible for analysing the water quality control.

d) Socio - economist and Financial Analyst

A qualified persons who have experiences in international projects. They will be responsible for studies regarding population and demand forecasts. financial analysis.

4. Assistance Requested

4.1 Experts

Item	No.	man-month
Project Manager	1	10
Water Supply Engineers	4	38
Water Resources Engineers	2	12
Water Treatment Expert	1	4
Socio-economist and Financial Analyst	2	11
Other Experts	2-3	10
Total	9-10	85

Justification for Requesting Experts

A team of experts will solve such complicated problems of the water supply systems and come up with master plans and feasibility studies. It is anticipated that through the mission of these experts, PWA counterparts will have been provided with their technical know-how's.

Job Description of Each Expert Requested

Project Manager

A highly qualified person who has experiences in the field of water supply and will be responsible for the progress results and recommendations of the investigation and preparation of the master plans and feasibility studies.

Experts

Highly qualified persons who have an extensive experiences in the field of the works indicated and involved in international works will be responsible for all phases of studies.

5. Thai Government Counterpart Contribution to the project

- office space and facilities at PWA
- laboratory facilities
- data provision
- data collection
- analysis asssistance and participation
- policy guidance

6. Report

The following reports in English shall be submitted to PWA and the donor during the course of the study .

1) Inception Report

Number to be submitted	:	20 copies
Period to be submitted	:	At the beginning of the first field survey
Contents	:	Outline of the study and methodology

2) Interim Report (Master Plan)

Number to be submitted	:	20 copies
Period to be submitted	:	At the end of the second month after the start of the Project
Contents	:	a) Study for served area b) Served population and estimation of water demand c) Progress of study items

3) Progress Report (Master Plan and Feasibility Study)

Number to be submitted	:	20 copies
Period to be submitted	:	At the end of every other month
Contents		a) Master Plan b) Progress of study items on Feasibility Study

4) Interim Report (Feasibility Study)

Number to be submitted	:	20 copies
Period to be submitted	:	At the end of the sixth month
Contents	:	Progress of all study items on Feasibility Study.

5) Draft Final Report (Feasibility Study)(Seven separate volumes-one for each waterworks)

Number to be submitted	:	20 sets
Period to be submitted	:	At the middle of the ninth month
Contents	:	Feasibility Study

6) Final Report (Seven separate volumes-one for each waterworks)

Number to be submitted	:	50 sets
Period to be submitted	:	At the end of the Project
Contents	:	a) Master Plan b) Feasibility Study

付－3　Scope of Work

SCOPE OF WORK
FOR
DEVELOPMENT PLAN AND FEASIBILITY STUDY
ON
PROVINCIAL WATER SUPPLY PROJECT
IN
THE KINGDOM OF THAILAND

AGREED UPON
BETWEEN
PROVINCIAL WATERWORKS AUTHORITY
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

BANGKOK
MARCH 29, 1988

DR. HIDENORI AYA
LEADER
JICA PRELIMINARY STUDY TEAM

DR. TAWAT WICHAIDIT
GOVERNOR
PROVINCIAL WATERWORKS
AUTHORITY

I. INTRODUCTION

In response to the request of the government of Thailand, the Government of Japan decided to implement a Development Plan and a Feasibility Study on Provincial Water Supply Projects (Phuket, Prachatipat, Patum Thani, Takua Pa, Phang Nga, Thung Song and Su Ngai Golok) in Thailand (hereinafter referred to as "the Study") within the general framework of technical cooperation between Japan and Thailand, which is set forth in the Agreement on Technical Cooperation between the Government of Japan and the Government of Thailand, signed on November, 1981.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation program of the Government of Japan, will undertake the Study, in accordance with the relevant laws and regulations in forth in Japan and in close cooperation with the authorities of Thailand. The Provincial Waterworks Authority (hereinafter referred to as "PWA") shall act as a counterpart agency to the Japanese Study Team and also a coordinating body in relation with other relevant organizations for the smooth implementation of the Study. The present document sets forth the Scope of Work for the Study.

II. OBJECTIVES OF THE STUDY

The objective of the Study are:

1. to prepare a development plan for Provincial Water Supply Projects in Phuket, Prachatipat, Patum Thani, Takua Pa, Phang Nga, Thung Song and Su Ngai Golok up to 2011.

2. to conduct a feasibility study in Phuket, Prachatipat, Patum Thani and Su Ngai Golok.

3. to transfer the technology to the Thai counterpart personnel in the course of the Study.

III. OUTLINE OF THE STUDY

The Study will be composed of field surveys and data collection in Thailand and of analysis works in both Thailand and Japan.

The items to be covered by the Study Team are as follows:

1. Phase I: Development Plan
    a. Data collection and analysis
    b. Delineation of served areas
    c. Projection of population and water demand
    d. Existing water supply system
    e. Water sources
    f. Formation of appropriate concept for water supply system
    g. rough cost estimation
    h. Identification of the projects for a feasibility study in Phuket, Prachatipat, Patum Thani, and Su Ngai Golok

2. Phase II: Feasibility Study
    a. Delineation of project areas
    b. Estimation of population to be served
    c. Estimation of water demand
    d. Water sources
    e. Alternative plans
    f. Layout of facilities
    g. Preliminary design
    h. Cost estimation
    i. Financial and economic analyses
    j. Water tariff
    k. Organization, operation and management
    l. Implementation schedule

IV. WORK SCHEDULE

The Study will be conducted in accordance with the tentative schedule as shown in the Annex I herewith attached.

V. REPORTS

JICA shall prepare and submit the following reports in English to the Government of Thailand.

(1) Inception report
- copies 20
. at the beginning of the first field survey

(2) Progress report
- copies 20
. at the end of the first field survey

(3) Interim report
- copies 20
. at the beginning of the second field survey

(4) Draft final report
- sets 20
. after 2 and half months from the end of the second field survey

(5) Final report with summaries
- sets 40
. within 1 month after recieving comments on the draft final report from PWA

The PWA shall submit its comments to JICA within one month after the receipt of the draft final report.

VI. UNDERTAKING OF THE GOVERNMENT OF THE KINGDOM OF THAILAND

1. In accordance with the Agreement on Technical Cooperation between the Government of Japan and the Government of the Kingdom of Thailand dated November 5, 1981, the Government of the Kingdom of Thailand shall accord benefits to the Japanese study team as follows:

(1) to permit the member of the Japanese study team to enter, leave and sojourn in Thailand for the duration of their assignment therein and exempt them from alien registration requirements and

consular fees,

(2) to exempt the member of the Japanese study team from taxes, duties and any other charges on equipment, machinery and other materials brought into Thailand for the conduct of the Study,

(3) to exempt the member of the Japanese study team from income taxes and charges of any kind imposed on or in connection with any emolument or allowance paid to the member of the Japanese study team for their services in connection with the implementation of the Study,

(4) to bear claims, if any arises against the member of the Japanese study team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the member of the Japanese study team.

2. To facilitate smooth conduct of the Study, PWA shall take necessary measures in cooperation with other relevant organizations:

(1) to secure permission for entry in to private properties or restricted areas for the conduct of the Study,

(2) to secure permission for the study team to take all data and documents (including photographs) related to the Study out of Thailand to Japan,

(3) to provide the medical services as needed (Its expenses will be charged on member of the Japanese study team.),

(4) to ensure the safety of the member of the Japanese study team when and as it is required in the course of the Study.

3. PWA shall, as its own expense, provide the Japanese study team with the followings:

(1) available data and information related to the Study,

(2) counterpart personnel,

(3) suitable office space with necessary equipments,

(4) credentials or identification cards.

VII. UNDERTAKING OF JAPAN

For the implementation of the study, JICA shall take the following measures:

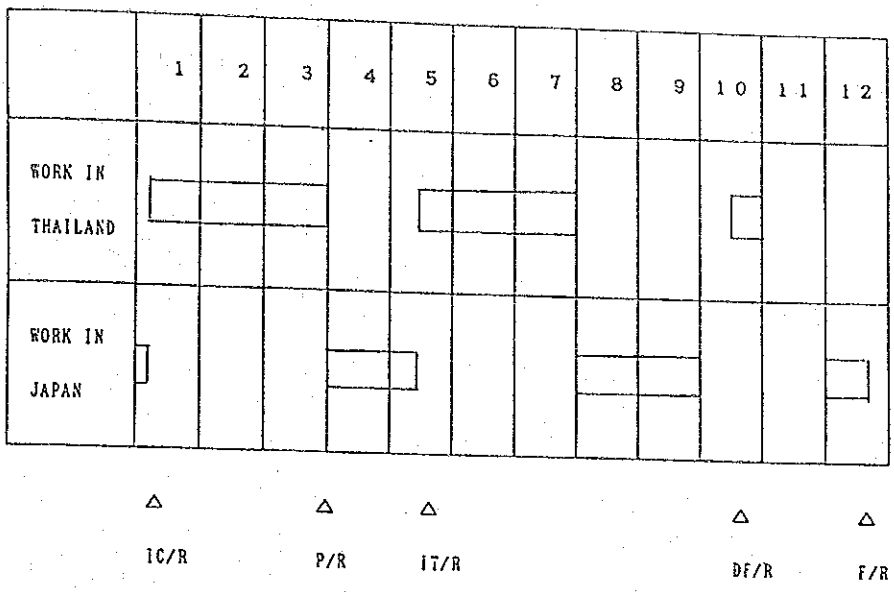
(1) to dispatch, at its own expense, study teams to Thailand,

(2) to pursue technology transfer to the Thai counterpart personnel in the course of study.

VIII. JICA and PWA shall consult with each other in respect of any matter may arise or in connection with the Study.

Annex 1

Tentative Schedule



付－4　Minutes of Meeting

MINUTES OF MEETING
ON
THE SCOPE OF WORK
FOR
THE DEVELOPMENT PLAN AND THE FEASIBILITY STUDY
ON
PROVINCIAL WATER SUPPLY PROJECTS

BANGKOK
MARCH 29, 1983

DR. HIDENORI AYA
LEADER
JICA PRELIMINARY STUDY TEAM

DR. TAWAT WICHAIDIT
GOVERNOR
PROVINCIAL WATERWORKS
AUTHORITY

MINUTES OF MEETING

The Japanese Preliminary Study Team and the Thai counterpart of PWA held a series of discussions during March 21 - 29, 1988, concerning the Scope of Works. The present minutes were prepared to confirm the main issues discussed and agreed upon by both sides.

Both sides confirmed the followings:

1. PWA proposed to add Betong into the study, but the request could not be accepted, since Betong was not included in the original request. Japanese team suggested that PWA could apply the study of Su Ngai Golok to Betong by themselves.

2. The Development Plan will be conducted to meet with minimum acceptable level for the next stage of planning and is by nature simpler than a master plan.

3. The economic analysis will be limited to the evaluation of direct benefits and costs, and will be conducted with data obtained during the course of the Study. The statements on the indirect benefits will also be included in the report.

4. The work schedule may be extended up to 14 months, if necessary to make the study more effective.

5. PWA requested appropriate number of counterparts be invited to Japan for technical training. Japanese team replied that any commitment could not be made at this stage, however, a favorable consideration will be given.

6. Japanese team emphasized that full cooperation from the Phuket Municipality was essential for the field study and requested PWA to make arrangement for that. PWA assured the appropriate arrangement.

7. Water quality analysis will be conducted at PWA laboratory, if necessary.

8. PWA will provide one microbus for the study in Bangkok, Prachatipat and Patum Thani. In other towns, supply of vehicle for the study team is very difficult, because the regional offices of PWA are far away from the study areas.

9. PWA asked Japanese team to take more attention on demographic studies of the towns, especially on Prachatipat, Patum Thani and Phuket, in which migration rate is very high and proposed that local socio-economic experts might be hired to work with the study team. Japanese team explained that it was not possible by the present system of development survey, however, the importance of demographic studies was recognized.

ANNEX

ATTENDANTS OF DISCUSSION

1. PWA side

Dr. Tawat Nichaidit	Governor
Dr. Wanchai Ghooprasert	Assistant Governor(Planning & Finance)
Mr. Chatpong Chucharoen	Director, Corporate Planning Dept.
Dr. Sarawoot Chayovan	Director, Planning Div.
Ms. Orapin Assavanig	Chief, International Cooperation Section
Mr. Wanchai Lowattanatrakul	Engineer, Planning Div.
Mr. Nived Vachira-Anan	Engineer, Planning Div.
Mr. Suthee Aaswapichaid	Engineer, Planning Div.
Mr. Pairoj Sattayasanskul	Engineer, Planning Div.
Mr. Jaroensuk Norapansopak	Engineer, Water Resources Development Proj.

2. JICA side

Dr. Hidenori Aya	Leader of JICA Preliminary Study Team Professor, Dept. Of Civil Engineering Musashi Institute of Technology
Mr. Takemitsu Yanagisawa	Member of JICA Preliminary Study Team Chief, Waterworks Bureau, Tokyo Metropolitan Government
Mr. Hisashi Yano	Member of JICA Preliminary Study Team Chief, Ministry of Public Health and Welfare
Mr. Toichi Iwata	Member of JICA Preliminary Study Team Social evelopment Cooperation Dept. Japan International Cooperation Agency

付－5　収集資料リスト

1. The Provincial Waterworks Authority (PWA) Plan For The Remainder Of The Water Decade (1987-1990)
2. Phuket Waterworks Project (Summary)
3. Statistical Reports

   Changwat Pathum Thani (パツンタニ), Changwat Phuket (プーケット), Changwat Phangnga (パンガとタクアパ), Changwat Nakhon Si Thammarat (ツンソン), Changwat Narathiwat (スンガイゴロク)
4. 水道施設図，地形図

   プラチャチパット，スンガイゴロク，ツンソン，パンガの各都市の浄水場平面図と区域内配管図，プーケット，ツンソンの1/50,000の地形図
5. 水質試験表

   1985年から1987年における各都市の原水と浄水の水質試験表，ただしプーケットは1987年分のみ
6. 水道料金表