REPORT
ON
BASIC DESIGN SURVEY
FOR
CONSTRUCTION OF THE ELEVATED RESERVOIRS
FOR
VIENTIANE WATER SUPPLY PROJECT

NOVEMBER 1981

JAPAN INTERNATIONAL COOPERATION AGENCY

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Preface

It is with great pleasure that I present this Basic Design Report on Construction of the Elevated Reservoirs for Vientiane Water Supply System in Laos.

This Report embodies the result of a basic design survey which was carried out from June 14th to July 12th, 1981 by the Japanese Survey Team commissioned by the Japan International Cooperation Agency, following the request of the Goverment of Laos.

The survey team had a series of discussions with the officials concered of the Goverment of Laos and conducted a wide scope of field survey and data analysis.

I sincerely hope that this report will be usefull as a basic reference for the development of the project.

I wish to express my deep appreciation to the officials concerned of the Goverment of Laos for their close cooperation extended to the team.

November 1981

Keisuke Arita

Keisuke Arita
President
Japan International
Cooperation Agency

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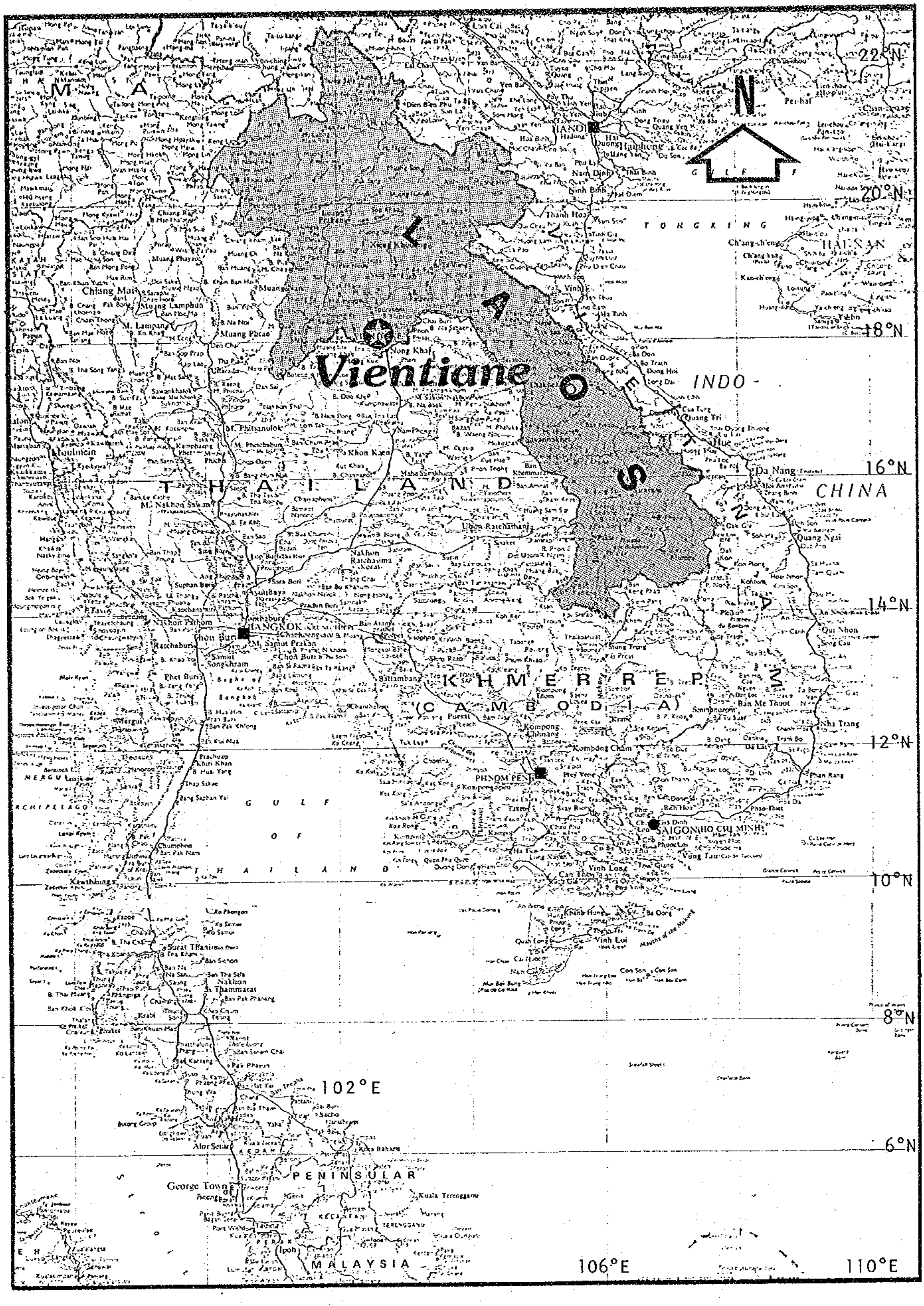


LAOS
Vientiane
HANOI
BANGKOK
PHNOM PENH
SAIGON (HO CHI MINH)
THAILAND
KHMER REP.
(CAMBODIA)
INDO-CHINA
VIETNAM
PENINSULAR MALAYSIA
GULF OF THAILAND
GULF OF TONGKING
N
22°N
20°N
18°N
16°N
14°N
12°N
10°N
8°N
6°N
102°E
106°E
110°E

1. INTRODUCTION

In response to the request of the Government of Lao People's Democratic Republic to the Government of Japan to consider a financial aid for construction of two elevated reservoirs which are the integral part of Vientiane water supply system, the Government of Japan decided to send a mission to Vientiane to investigate the existing water supply system including the future extension plan and to carry out the basic design survey on the proposed elevated reservoirs.

The Mission was sent by the Ministry of Foreign Affairs of Japan through Japan International Cooperation Agency (JICA) on 14 June through 12 July 1981 and was composed of a Japanese government official from the Ministry of Foreign Affairs, a JICA officer and three consulting engineers.

The present report, therefore, is prepared to describe findings obtained during the field visit with respect to the existing water supply system in Vientiane including the local expertise, equipment and materials available, proposal for construction of the most appropriate size of elevated reservoirs, cost estimates, implementation arrangement and evaluation of the project benefits.

It should be noted that the implementation arrangement is prepared based on the understanding that the civil engineering work will be carried out by Nam Papa, executing agency of recipient country or the construction section of the Ministry of Transportation, Public Works and Communication on the subcontract basis with a Japanese main contractor under a periodical supervision by a Japanese engineering consultants.

Relevant data and information such as manpower, equipment and materials locally available, machine and equipment to be imported, cost data, etc. are presented in appendices.

2. EXISTING WATER SUPPLY SYSTEM

2.1 General

Vientiane is the capital city of Laos with a total area of about 5,230 ha. The city is bounded by the Mekong River in the southwest and extends to the northeast as for as Phon Keng. The total population is about 250,700 at present. The major economic activities include commercial business, wood manufacturing and agriculture.

The road networks in Vientiane are considered sufficient at present. However, only main thoroughfares are asphalted. Although the public transportation is available, people mostly rely on their own bicycles or tricycles.

Since the completion of Chinaimo treatment plant in the end of 1980, the water supply capacity is considered sufficient except the distribution system including storage facilities. The power supply is also sufficient after completion of Nam Ngum power development project. However, the power distribution lines do not cover the entire area of the city of Vientiane, especially the city environs where people still rely on fuel lamps.

Since 1975, most of business in the private sector in this country have been replaced with those of the public enterprises. All civil works of infrastructures in the public sector are, therefore, undertaken by the Government itself. The income level of people in this country is relatively low with an average monthly income of about 700 Kip/family which is equivalent to about US$14 at an effective market rate of US$1 = Kip 50.

2.2 Water Sources and Water Treatment Plants

There are two water treatment plants in operation at present, one in Kaolieo and the other in Chinaimo as shown in Fig. 1. Both the plants derive the water from the Mekong River. The quality of water from the Mekong River is variable depending on the seasons. The turbidity is 50 -

300 ppm during the dry season, December - June and 500 - 2,000 ppm during the wet season, July - November. The water is susceptible to the present method of treatment system. Salient features of the two treatment plants are as follows:

Kaolieo Treatment Plant

1) Production Capacity

The water production recorded in 1979 - 1980 was available and is presented in Table 1. The average daily production during this period was about 19,200 m^3/day.

The present daily production of the plant is about 17,000 m^3/day in average. Among the four distribution pumps, three are operated from 6:00 a.m. to 22:00 p.m. and two are from 22:00 p.m. to 6:00 a.m. at present.

Table 1 Water Production of Kaolieo Treatment Plant

Month	Monthly Production (m^3/month)	Water Sold (m^3/month)	Water Sold (%)	Ave. Daily Production (m^3/day)
Sep 79	578,510	-	-	19,280
Oct	575,300	-	-	18,560
Nov	589,980	-	-	19,670
Dec	594,250	-	-	19,170
Jan 80	566,340	458,386	81.0	18,270
Feb	562,260	442,748	78.7	20,080
Mar	561,490	458,761	81.7	18,110
Apr	615,960	434,762	70.6	20,530
May	581,820	442,921	76.1	18,770
Jun	615,370	465,136	75.6	20,510
Jul	597,110	416,695	69.8	19,260
Aug	551,350	384,695	69.8	17,790

2) Water Treatment Process

As shown in Fig. 2, the water is pumped at the intake tower from the Mekong River and transmitted to a receiving well where coagulant (aluminium sulphate) and coagulant aid (sodium carbonate, or 'soda ash') are added to the water. The water is then distributed to four sedimentation basins through the flocculation basins of zigzag type. After sedimentation, the water is filtrated in two stages in the rapid sand filters, firstly in the gravel filters of upflow type and secondly in the sand filter of gravity flow type. The filtrated water is delivered to the town after chlorination. Chlorination is made by dosing the solution of breaching powder (calcium hypochlorite) into the reservoir.

Chinaimo Treatment Plant

1) Production Capacity

Although the plant was completed in the end of 1980, it is still under test operation with the daily water production not necessarily constant. The average daily production under test operation is recorded at 17,500 m^3/day. Among three delivery pumps, one is alternately in operation at the four-hour interval at present. The current delivery period from 5:00 a.m. to 22:00 p.m. will be practiced until completion of the whole distribution pipe designed under ADB financed project. Table 2 shows the water production recorded in May and June 1981.

Table 2 Water Production of Chinaimo Treatment Plant

Date	Ave. Daily Production (m^3/day)	Service Period (hr./day)
27 May 81	31,190	
28	1,134	
29	16,918	
30	16,710	
31	15,570	
1 June 81	16,710	
2	15,910	24 hrs.
3	19,460	
4	17,379	
5	16,621	
6	17,970	
7	17,930	
8	19,150	
9	17,890	
10	15,940	
11	-	
12	18,470	
13	15,340	
14	14,510	
15	18,880	16-17 hrs.
16	16,150	
17	14,160	
18	15,560	
19	15,450	
20	15,450	
21	17,140	
22	15,340	

2) Water Treatment Process

As shown in Fig. 3, the water is firstly pumped at the intake tower at the bank of the Mekong River and transmitted to the mixing chamber through the raw water conduit of D 1,000 mm to D 800 mm steel pipe. The water is then distributed to two sedimentation basins through mechanical flocculation basins. The flocculation basins are equipped with four flocculators. After sedimentation, the water is filtrated in the rapid sand filters of air cum backwash water type. The filtrated water is finally conveyed to a pumping chamber and is delivered to the town after chlorination.

2.3 Water Distribution System

The present water distribution network is shown in Fig. 1. Kaolieo distribution system mainly covers the western and central parts of the city and Chinaimo distribution system covers the eastern and northeastern parts of the city although both the systems are interconnected to supplement to each other.

1) Distribution Pipelines

Table 3 shows the lists of existing pipelines in Vientiane. The total length of pipelines is 105.2 km including those pipelines currently under construction.

Table 3 Lists of Existing Pipelines

Dia (mm)	Length (km)	Material	Year of Installation	Remarks
Kaolieo System				
450	4.42	DIP	1964	
300	2.03	"	"	
250	1.27	"	"	
200	6.79	"	"	
150	14.93	"	1964/68	
100	6.90	ACP/PVC	"	
75	10.55	"	"	
50	5.64	"	"	
50	5.64	"	"	
Total	52.53 km			
Chinaimo System				
1,000	0.47	SP	1980	
700	2.53	"	"	
600	4.22	"	"	
450	4.53	"	"	2,260 m under construction
400	4.93	"	"	1,508 m under construction
350	3.79	"	"	867 m under construction
250-80	23.59	ACP	"	4,000 m under construction
Total	44.06*			

* Excluding pipelines under construction.

Pipe materials installed consist of steel, ductile cast iron, asbestos cement and polyvinyl chloride.

Since the completion of Chinaimo treatment plant, leaks on pipelines have reportedly increased due to the past poor maintenance and the increased water supply pressure. NPP's repair and abatement work against these leaks are considered insufficient due to lack of personnel.

Wastage is also considered large since a number of defective or uncontrolled household faucets which were maintained during the time of poor water supply pressure are considered to be still used.

2) Storage Facilities

There are three storage facilities in Vientiane. The clear water reservoir in Kaolieo treatment plant has a capacity of 4,000 m^3 with underground construction. This reservoir serves to maintain the continuous water supply during the period when the treatment plant falls into out of order by troubles such as power failure, etc.

The elevated reservoir at Phone Kheng has a capacity of 2,000 m^3. Due to insufficient water supply pressure, the reservoir can not be filled with water and is not servicable at present. However, this reservoir will be put into service when Chinaimo water supply system is completed and sufficient water pressure is available.

The elevated reservoir at Bungkhangnong was constructed in 1934 with a capacity of 320 m^3 for supplying water to a nearby French compound, but it has not been used for a long time. Therefore, it is doubtful whether it is still in a serviceable condition.

2.4 Water Service System

Water is supplied to consumers solely through service connections totaling about 8,500. No public standpipe is existing. Almost all the service connections are equipped with service water meters. Water tariffs are levied on a quantity basis. NPP has a plan to install another 2,000 service connections with meters within the next two years.

2.5 Water Tariff

Water tariff is levied to consumers on the consumption basis through service water meters.

The water tariff in 1979 was 0.4 kip/m^3 and that in 1980 - 81 is 1.15 kip/m^3 which is still very low in comparison to those in other countries of this region. This is due to the government tariff policy to salvage lower income people.

The connection charge for installation of service connection including water meter is 900 Kips up to 10 m, 1,100 Kips from 10 to 20 m and 1,200 Kips from 20 to 30 m long of the service pipe.

The revenue and the expenses recorded in 1980 for Vientiane water supply system is as follows:

Revenue: 4,805,676 Kip
(Water tariff, connection charge, etc.)

Expenses: 3,757,158 Kip
(Operation & maintenance costs excluding salaries of administrative personnel)

As is seen above, NPP is financially self sustaining and the benefit in 1980 amounted to 1,048,518 Kip.

The average monthly water bill per family recorded in 1980 was 21.15 Kip with its average consumption of 21 m^3 1/ while the average monthly income per family was projected about 700 Kip at present. Assuming that 4% of the family income is the maximum amount which the average residence can afford to pay for water, the maximum payable amount is calculated at 700 Kip x 4% = 28 Kip. Therefore, it is understandable that the present tariff rate of 1.15 Kip is reasonable being at the level of consumer's ability to pay.

1/ Average monthly consumption per family which was actually billed by NPP in 1980.

3. POPULATION AND POPULATION SERVED

3.1 Present and Future Population

Two actual census data on population of the city of Vientiane are available for 1964 and 1973. From 1975 to 1980, the populations estimated by the municipal office of Vientiane are available and are presented in Table 3.1 below.

Table 3.1 Population Growth in Vientiane

Year	Population	Growth Rate (%)
1964*	132,253	-
1973*	179,000	3.4
1975	243,346	16.6
1976	239,760	-1.5
1977	238,424	-0.6
1978	265,595	11.4
1979	248,370	-6.5
1980	250,714	1.0

* Census data for 1964 and 1973.

Up to 1975, the population of Vientiane had increased at high rates of 3.4 to 16.6 per cent per annum, especially in 1974 - 75 when country dwellers were considered to migrate to the city of Vientiane in order to avoid dangers during the war time.

From 1976 up to date, the population has almost unchanged. This is considered to be due to the government policy for migration of city dwellers to rural areas as well as evacuation of foreign residents.

With return of political and economical stability, it is expected that the future population of Vientiane will increase gradually at the rate of 1.5 per cent up to 1985 and, thereafter, the growth rate will be slightly accelated to reach 3.5 per cent per annum in the year 2000, the same rate as was recorded in 1973 or before, as presented in Table 3.2 below.

Table 3.2 Estimation of Future Population

Year	Population ('000)	Growth Rate (%)
1980	251	0.6
1985	270	1.5
1990	305	2.5
1995	354	3.0
2000	420	3.5

3.2 Present and Future Population Served

Based on the information provided by NPP, the population served and the number of service connections existing during the period of 1977 to 1980 are presented in Table 3.3 below.

Table 3.3 Population Served and Service Connection

Year	Population	Population Served	Served Ratio (%)	No. of Connection
1977	238,424	83,846	35.2	5,450
1978	265,595	100,726	37.9	7,560
1979	248,370	113,500	45.7	8,120
1980	250,714	120,000	47.9	8,917

The number of consumers per connection averages about 13 people. NPP has a plan to install another 2,000 service connections within the next two years. It is, therefore, expected that by the end of 1982, the number of service connections amounts to about 10,900 and the total population served to 141,700 people. Considering that there is high potentiality of consumpers to have service connections as NPP reported, the future population served is projected as shown in Table 3.4

Table 3.4 Future Population Served

Year	Population	Served Ratio	Population Served	No. of Connection	No. of Consumers Per Connection
	('000)	(%)	('000)		
1980	251	47.9	120	8,917	13.5
1982	259	54.8	142	10,900	13.0
1985	270	60	162	12,500	13.0
1990	305	70	214	17,800	12.0
1995	354	80	283	25,700	11.0
2000	420	90	378	37,800	10.0

The served ratio is projected to increase from the present rate of about 48 per cent to 90 per cent in 2000 with its number of consumers per connection from 13.5 at present to 10 persons in 2000 in average.

4. WATER DEMAND PROJECTION

In general, the water demand is projected for domestic and non-domestic consumptions. The former is projected on the basis of population served and per capita consumption while the latter is projected indivisually for various categories of consumption such as industries, hospitals, shops, schools, etc. However, for Vientiane where non-domestic demand is negligible and domestic consumption is predominant, the water demand is projected as the product of population served and per capita consumption. Per capita consumption is projected on the basis of the present consumption of 160 lpc and 225 lpc in the year 2000 which was proposed by ADB.

According to information obtained by NPP, it is estimated that the present water losses which include wastage, leakage and others amount to about 40 per cent of the water production. It is projected that these water losses will be reduced gradually to 10 per cent in the year 2000, by implementing leakage control program, replacing old pipe materials, etc.

The water demand, thus far obtained is presented in Table 4.1 and Fig. 4.1.

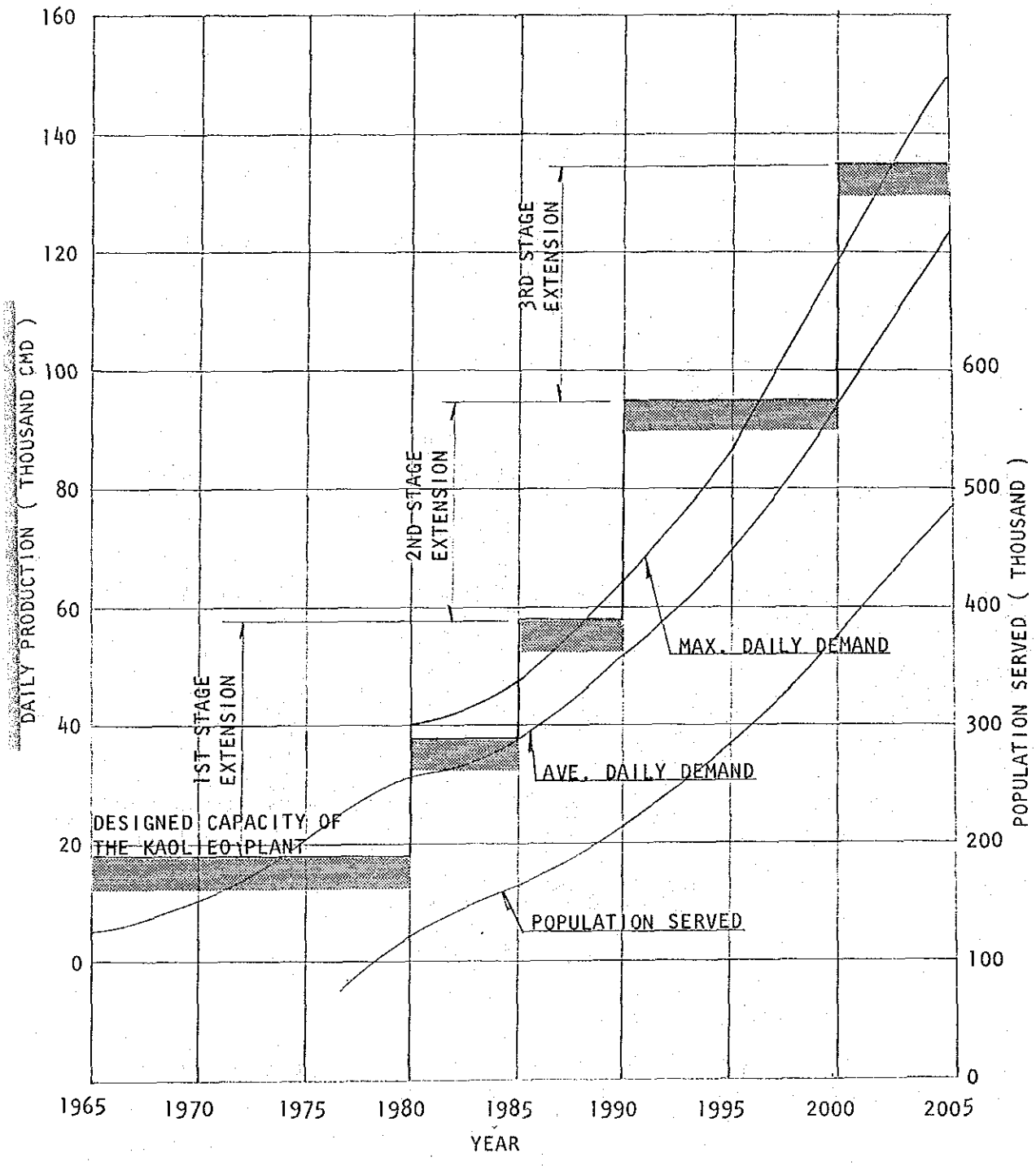
Table 4.1 Water Demand Projection

Year	Population Served ('000)	Per Capita Consumption (lpcd)	Water Losses (%)	Ave. Daily Demand ('000 m^3)	Max. Daily Demand 2/ ('000 m^3)
1973 1/	82	134	26.0	14.0	14.0
1981	120	160	40.0	32.0	40.0
1982	142	166	30.0	33.7	42.1
1985	162	176	25.0	38.0	47.5
1990	214	192	20.0	51.4	64.3
1995	283	208	15.0	69.3	86.6
2000	378	225	10.0	94.5	118.1

1/ Data presented in ADB appraisal report.

2/ 1.25 times the average daily demand.

FIG. 4.1 POPULATION, DEMAND AND PRODUCTION PROJECTION



5. PROPOSED WATER RESERVOIRS

5.1 General

This Chapter aims to describe a plan for constructing the most appropriate water reservoirs and the planning year to be targeted.

In planning water supply facilities, it is an ordinary practice to set a target year for the next 10 years, taking into account the future water demand, costs for construction and maintenace, availability of funds required, finanncial circumstances, etc. In case of Vientiane where no extension plan is expected in the near future and no remarkable change of population is foreseen, a span of 10 years as normally employed is considered appropriate for the present study.

5.2 Location of Reservoirs

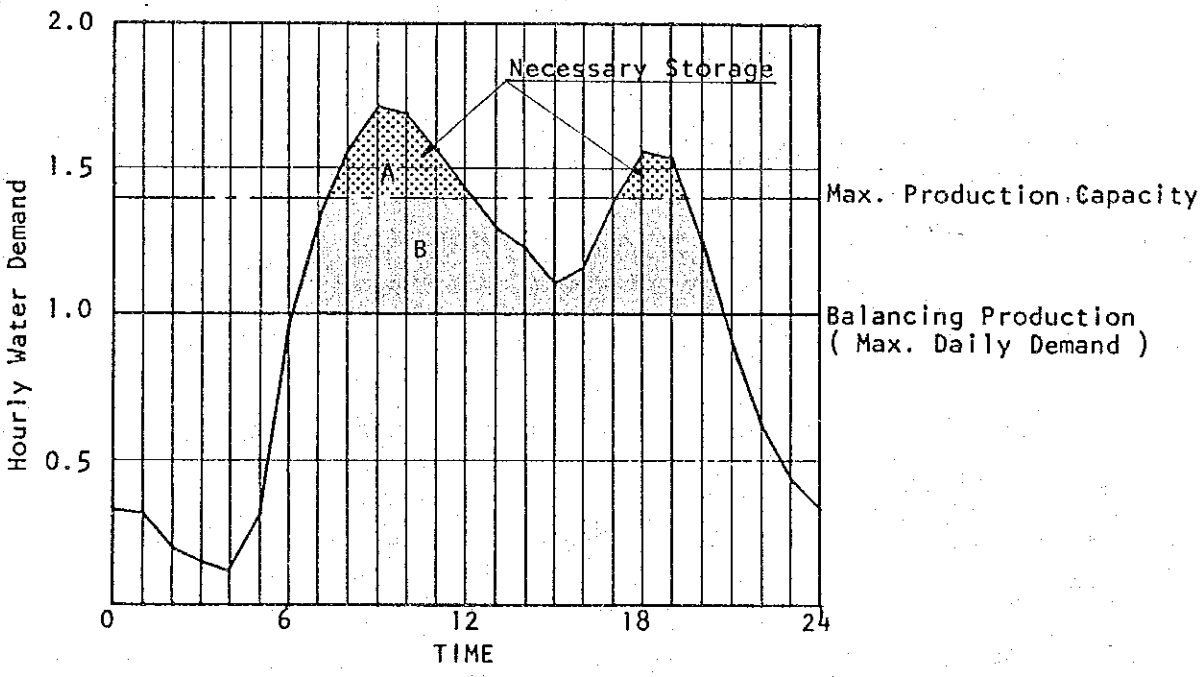
As mentioned in Section 2.1, the existing storage facilities are located in Kaolieo and Phone Khene. Storage facilities are, in general, to be constructed for the purpose of filling the gap between the water production and the water demand which flucuates hourly, and to maintain a continuous supply even during the period of power failures and other abnormal cases. Therefore, these facilities should be located near the areas to be covered as far as possible. In case of Vientiane where the water demand may mainly concentrate in the central and the northeastern parts of the city, construction of two elevated reservoirs at Phone Thanh and Phone Tong as proposed by NPP is considered appropriate and is shown in Fig. 1.

5.3 Capacities of Reservoirs

Balancing storage is normally determined at such capacity that it will cover the gap between the water demand and the water production during the peak hourly periods, taking into account cases for fire fightings, power failures, etc.

As is seen in Fig. 5.1 Hourly Fluctuation of Water Demand recorded in a typical city of this region, the gap between the peak hourly demand and the maximum daily demand is equivalent to 5.7 hours of the maximum daily demand (area A + B). Since there is no data available other than the above, the storage capacity of 6 hours equivalent, including requirements for fire fightings, etc., is employed for the present study.

Fig. 5.1 Hourly Fluctuation of Water Demand



The water production, the maximum daily demand and the necessary storage thus far estimated up to the year 2000 are presented in Table 5.1 below.

Table 5.1 Projection of Storage Capacities

Particular	1973	1981	1985	1990	1995	2000
Water Production 1/	15,000	38,000	58,000	95,000 2/	95,000	135,000
Max. Daily Demand	14,000	40,000	47,500	64,300	86,600	118,100
Necessary Storage 3/	3,500	10,000	11,900	16,100	21,700	29,500

1/ Water production from Kaolieo and Chinaimo treatment plants.

2/ The second stage extension project for Chinaimo plant completed and production of Kaolieo treatment plant reduced to 15,000 m^3 from 1990 and onward.

3/ Necessary storage estimated on the basis of 6 hours equivalent of the maximum daily demand.

The necessary storage for the year 1990, targeted year of the present study, amounts to 16,100 m^3. However, as is seen in the above table, the water production will exceed the maximum daily demand in 1990 in case the second stage extension project is completed and this allows to reduce the necessary storage by uprating the water production of the treatment plants to the maximum extent during the peak hourly period. Therefore, the storage capacity finally required is the necessary storage above estimated (areas A + B) less the uprated water production of the plants (area B) i.e. 16,100 - 11,000 = 5,100 m^3.

Since the existing storage has the capacity of 2,000 m^3, necessary storage required for elevated reservoirs becomes 3,100 m^3 in total in 1990. Consequently, construction of two elevated reservoirs with the capacity of 1,500 m^3 each at the sites as proposed is recommended for the project.

5.4 Type, Shape and Construction

In order to propose the most appropriate storage system, two types of reservoir, underground and elevated, with construction of brick, reinforced and steel materials are considered with respect to the following points:

1) Easiness of operation of the water supply system
2) Economy in cost of construction and maintenance
3) Easiness for construction

4) Dependability for leak

5) Aesthetic appearance

As a result, a reservoir of underground type is firstly excluded from consideration since it requires pumping facilities to deliver the water from the reservoirs to areas served where the stable power supply is not available.

Construction of reservoirs with reinforced concrete or steel material is then considered and it is found that a reservoir of reinforced concrete is more recommendable than the other due to economy and easiness in maintenance and durability of life as well as easiness in construction with local expertise and manpower.

In order to determine the shape of the elevated resrevoir, three alternatives are finally considered as shown in Fig. 4. Among these alternatives, Alternative No. 1 is recommended due mainly to easiness in construction work.

With respect to the technical viability for construction of the proposed elevated reservoirs which may be undertaken by the local expertise, a survey on the existing structure was made, especially on facilities of Chinaimo treatment plant. It is found that the concrete work was performed satisfactorily with designed strength and finishing. For the intake tower which was similar to the proposed elevated reservoirs in its height and scale, it is also found that the structure was completed with satisfactory workmanship, Therefore, it can be said that the local expertise will be able to construct the proposed reservoirs satisfactorily if special cares for scaffolding, water proofing, etc. is taken with supports of fcreign expertise.

With respect to the local construction materials such as gravel, sand, woods, etc. it is found that the quality of gravel and sand is in general acceptable for concreting although it was observed that some deteriorated or oversized particles are included in the material as described in Appendix 5.

6. OUTLINED DESIGNS OF PROPOSED ELEVATED RESERVOIRS

Outlined designs of the two proposed elevated reservoirs to be constructed at Phone Thanh and Phone Tong are presented in Fig. 5. The capacity of each reservoir is 1,500 m^3 with their heights from the ground surface to the high water level of 31 and 26 m, respectively. The reservoirs are of cylindrical type with an effective depth of 5.5 m. The inside surface of the reservoir will be covered with water proof material of synthetic resin. The footing of the reservoirs is of flat type without piling. The reservoirs are designed with the following design criteria:

Effective capacity of the reservoir:	1,500 m^3	
Water levels No. 1:	HWL 31 m and LWL 25.5 m	
No. 2:	HWL 26 m and LWL 20.5 m	
Soil bearing strength:	20 ton/m^2	
Wind velocity	: 45 m/sec	
Earthquake	: Not considered	
Designed compressive strength (reinforced concrete) after 28 days	:	210 kg/cm^2
Allowable compressive strength	:	70 kg/cm^2
Designed compressive strength (lean concrete) after 28 days	:	120 kg/cm^2
Allowable tensile strength of steel bar (SD 30)	:	2,000 kg/cm^2

7. COST ESTIMATES

The cost estimates for construction of the two proposed elevated reservoirs are presented in Table 7.1 below. The total cost amounts to 600 million Japanese Yen (2.6 million US dollars equivalent), out of which 522.3 million Japanese Yen (2.27million US dollar equivalent) belong to foreign currency portion and the rest of 77.7 million Japanese Yen (0.33 million US dollars equivalent) to local currency portion. The foreign currency portion includes procurement of construction equipment, imported

construction materials and tools, remuneration, and overhead expenses for the foreign contractor plus consulting service fee. The local currency portion includes local labor cost, procurement of local construction materials, temporary establishment cost, local office expenses, fuel and power.

The estimates for the local currency portion are made based on the information provided by NPP. The local labor cost is estimated based on the numbers of skilled and unskilled laborers, as shown in Appendix 2, which NPP assumed necessary for construction of the two reservoirs and the daily wage rates of 50 kip/day for an unskilled laborer and 150 kip/day for skilled laborer. The estimates for procurement of the imported equipment and materials are made at CIF Vientiane prices. The estimates are based on prices prevailing in July 1981 without consideration on price escalation.

Table 7.1 Cost Estimates for Construction of Two Elevated Reserviors

US$1.0 = Kip 10 = ¥230

	Item	Description	Amount ('000 Yen)
1.	Imported materials	Cement, steel bar, water proof materials, scaffolding, stairs, etc.	162,000
2.	Imported machines	As listed in Appendix 3	164,700
3.	Hand tools	Carpentor's hand tools, shovels, etc.	6,500
4.	Pipe, fittings and lightening rods		11,400
5.	Expatriate's expenses	Remuneration, out-of-pocket and other expenses	84,700
6.	Local labor cost	Skilled and unskilled	39,700
7.	Locally produced materials	Sand, gravel, woods, etc.	33,500
8.	Fuel and power		4,500
9.	Contractor's overhead expenses	Overhead cost and profit	68,000
	Total		575,000
10.	Consulting Fee	Design and supervision	25,000
	Total		600,000

8. IMPLEMENTATION ARRANGEMENT

8.1 Implementation Schedule

An implementation schedule for the project is presented in Fig. 8.1. The project requires 18 months in total. It will start with detailed designing and preparation of specifications and other relevant documents to be undertaken by engineering consultants. Prior to mobilization of a Japanese contractor to the site, preparation and cleaning of the project sites will be undertaken by the executing agency of the recipient country in accordance with the guidelines of the Japan's grant aid program. Following the execution of the contract for the project with a Japanese contractor, construction work will be commenced. The total construction period is estimated at 15 months in total.

8.2 Implementation Set-up

An implementation set-up for implementing the project is shown below. It is expected that a Japanese consulting firm will be recruited to carry out designing and construction supervision of the project and a Japanese contractor to carry out construction work of the project. In accordance with Memorandum of Discussion prepared between the JICA Mission and NPP on 8 July 1981, it is expected that NPP or the construction section of the Ministry of Communication, Public Works and Transportion undertakes the civil engineering work on the subcontract basis with the Japanese contractor and supplies necessary man power and locally available materials as listed in Appendix 2 and 5.

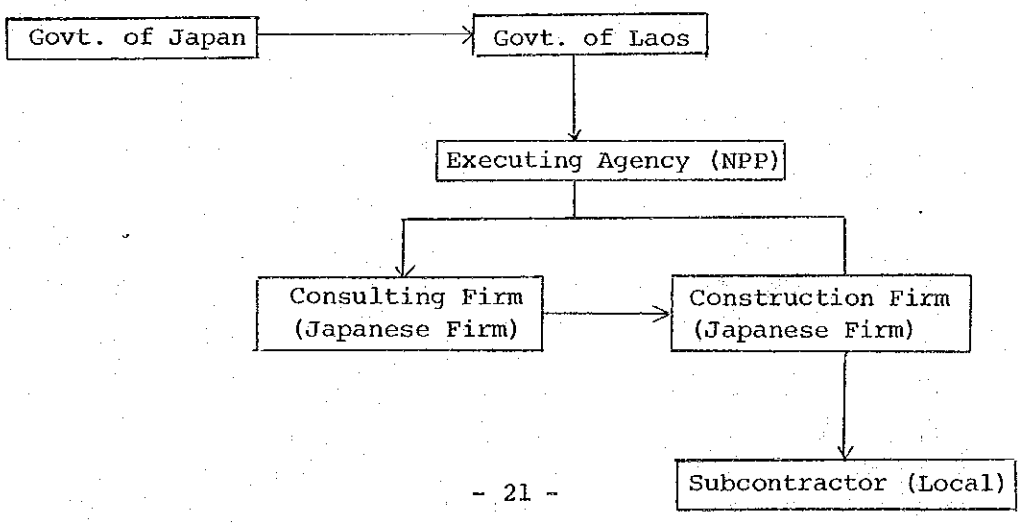
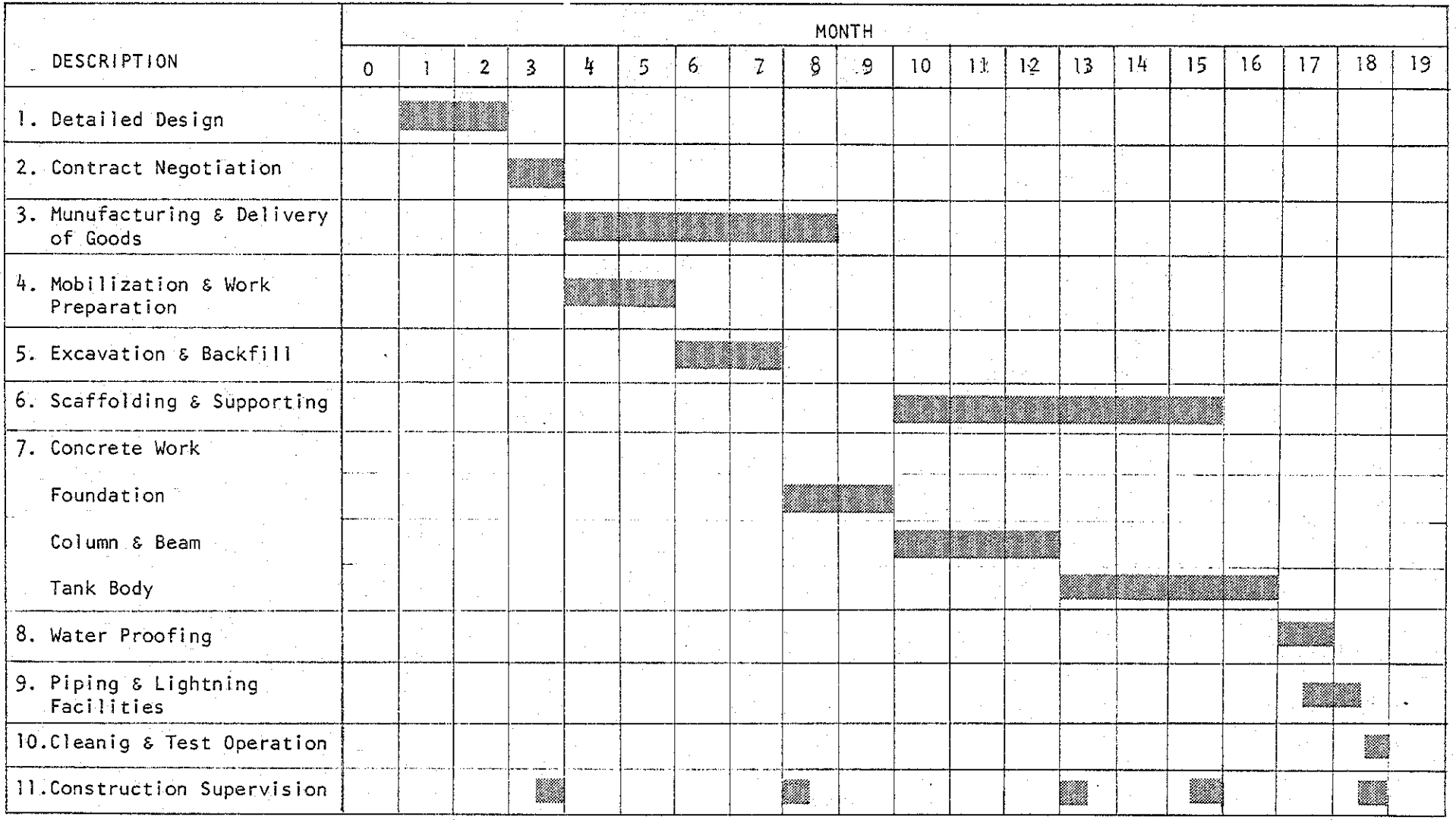


FIG. 8.1 IMPLEMENTATION SCHEDULE



9. EVALUATION OF BENEFITS OF THE PROJECT

A brief description of each of the benefits likely to accrue to Nam Papa and people in the area served by way of implementing the project is presented below:

1) Revenue Measured Benefit

The benefit that NPP will obtain directly by constructing the reservoirs is measured by the amount of water revenue produced by the water supply from the reservoirs, i.e. the product of the storage capacity and the water rate is the measured benefit daily obtained. In addition, the water supply to be secured during the power failure is also considered as benefit accrual to NPP.

2) Fire Prevention

According to information obtained from NPP, the numbers of fire incidents recorded in the past three years are 32 in 1978, 45 in 1979 and 37 cases in 1980. These cases could have been reduced if sufficient water was available for fire suppression activities.

3) Health Benefit

The insufficient water supply pressure will result in back-syphonage of contaminated water into water supply pipelines and the consumers' water taps to be vulnerable to pollution. In case, therefore, the water supply pressure is improved, water-borne and related diseases will be reduced to a certain extent.

4) Economic Benefit

In case the water supply condition is improved, economic activities will be inspired in the area served and employment in commercial and trade businesses will be generated.

Among the above four benefits considered, the revenue measured benefit is calculated as follows:

1) Revenue Resulting from the Peak Hourly Demand

The water revenue is considered to be produced daily by supplying water from the reservoirs during the peak hour and therefore is calculated as follows:

Storage capacity : 1,500 m^3 x 2

Water tariff in 1980 : 1.15 Kip/m^3

Water revenue = 1,500 x 2 x 1.15

= 3,450 Kip/day

Assuming that the water supply from the reservoirs during the peak hour occurs for about 70 per cent (250 days) of the days of a year, the yearly revenue is:

Yearly water revenue = 3,450 Kip/day x 250 days

= 862,500 Kip/year

2) Revenues Resulting from the Power Failures

According to information obtained from NPP, there were 1 to 2 times of power failures occuring every month in 1980. Therefore, the water revenue to be produced by supplying the water during the period of power failure is estimated as follows:

Water revenue = 1,500 x 2 x 1.15 x (1 or 2)

= 3,450 to 6,900 Kip/month

= 41,400 to 82,800 Kip/year

A P P E N D I C E S

COST DATA FOR ESTIMATION OF ELEVATED RESERVOIRS

This Appendix presents cost data used for cost estimate of the proposed elevated reservoirs. The data presented herein are based on those prevailing in Laos and in Japan as of July 1981.

The costs of local labourers are those proposed by NPP who is supposed to supply the labourers to the main contractor. The monthly rates are calculated based on the daily rates and the assumed working days per month.

The prices of locally available materials are those informed by NPP and are supposed to be prevailing in Vientiane at present. No transportation cost is included in the costs of sand, gravel and wood, i.e. the prices are ex-factory prices.

The prices of imported materials and construction machines are those prevailing in Japan at present. Shipping cost is included in these prices.

Table 1 Labour Cost

Description	Unit Rate (Kip/day)	Unit Rate (Kip/month)
Skilled Labour	150	3,600
Unskilled Labour	50	1,200

Table 2 Locally Available Material

Description	Unit	Unit Rate (Kip)
Sand	m^3	90
Gravel	m^3	140
Wood	m^3	4,500

Table 3 Imported Material

Description	Unit	Unit Rate (Yen)
Cement	ton	43,100
Steel bar	ton	100,000
Water proofing material	m^2	4,000

Table 4 Construction Machines

Description	Capacity	Unit Price ('000 Yen)
1. Bulldozer	D30S	22,000
2. Back hoe	0.3 m^3	9,800
3. Shovel (Payloader)	0.5 - 0.8 m^3	7,600
4. Dump Truck	6 - 8 t	6,200
5. Pickup Truck	1500 cc	1,200
6. Concrete Mixer	1.0 m^3	7,300
7. Bar Bender	electric	1,500
8. Bar Cutter	electric	1,200
9. Air Compressor	w/accessories, 2 - 3 m^3/min	2,000
10. Weight Batcher		1,000
11. Concrete Vibrator	Electric, bar type	150
12. Motor Bicycle	70 cc	130
13. Concrete Tower	2 ton, 35 m	9,100
14. Mini bus	12-15 sheats	2,300

LIST OF MANPOWER AND EQUIPMENT TO BE PROVIDED BY THE EXECUTING AGENCY

MANPOWER

		Persons
1.	Professional (NPP) (Project Manager, Clerks, Engineers, Surveyors, etc.)	10
2.	Trademan (Skilled labourers) 21 persons/gang x 2 gangs/reservoir x 2 reservoirs one gang consists of: 2 - foremen 3 - steel bar fixers 8 - carpenters 4 - plaster (concrete) men 4 - operator/mechanic	84
3.	Labourers (Unskilled labourer)	80

Note: The numbers of skilled and unskilled labourers describes those employed during the dry season and these are reduced into half during the rainy season.

EQUIPMENT

Particular	Capacity	Unit	Manufacture
Backhoe	0.6 m^3	1	Inter, USA
Cargo truck	6-8 ton	2	Fuso, Japan
Dump truck	8 ton	3	Isuzu, Japan
Pickup truck	3000 cc	2	Mazda, Japan
Water tanker		2	Fuso, Japan
Bar bender	electric	1	
Bar cutter	electric	1	
Concrete dumper		4	
Air compressor	w/ accessories	1	
Welder		2	

PIPE AND VALVES*

Steel pipe	ø400	240 m
	ø200	100
Bell mouth	ø450	1 pc
	ø400	1
Gate valve (Outlet)	ø450	2
(Inlet)	ø400	2
(Bypass)	ø200	4
Check valve (Bypass)	ø200	2
Automatic water level control valve	ø400	2

* These pipe, fittings and valves are supposed to be provided by NPP, but some should be procured if needed.

LIST OF MACHINES/EQUIPMENT, TOOLS AND MAJOR MATERIALS TO BE IMPORTED

MACHINES/EQUIPMENT AND TOOLS

Particular	Capacity	Unit	Remarks
Buldozer	D30	1	
Backhoe	0.4 m^3	2	Wheel type
Shovel (Payloader)	0.5 m^3	2	
Dump truck	8 ton	4	
Mini bus	12 seats	1	
Concrete mixer	1.0 m^3	2	w/ weight batcher
Bar bender	electric	1	
Bar cutter	electric	1	
Air compressor w/accessories	2-3 m^3/min.	2	
Pickup truck	1500 cc	1	
Concrete vibrator	engine type	3	bar type
Motor bicycle	70 cc	4	
Concrete tower	1-2 ton x 35 m	2	
Steel scaffolding	steel	2	pipe/formed steel
Carpenter hand tool		20	
Mason hand tool		20	
Spare parts for NPP owned equipment		L.S	

MATERIALS

Particular	Description	Unit
Cement	portland	1,100 ton
Steel bar	deformed	400 ton
Water proofing material		1,600 m^2
Concrete admixture		L.S.
Wiring rod for steel bar		L.S.
Nail and others		L.S.
Water pipe and specials		L.S.
Ligthning facilities		L.S.

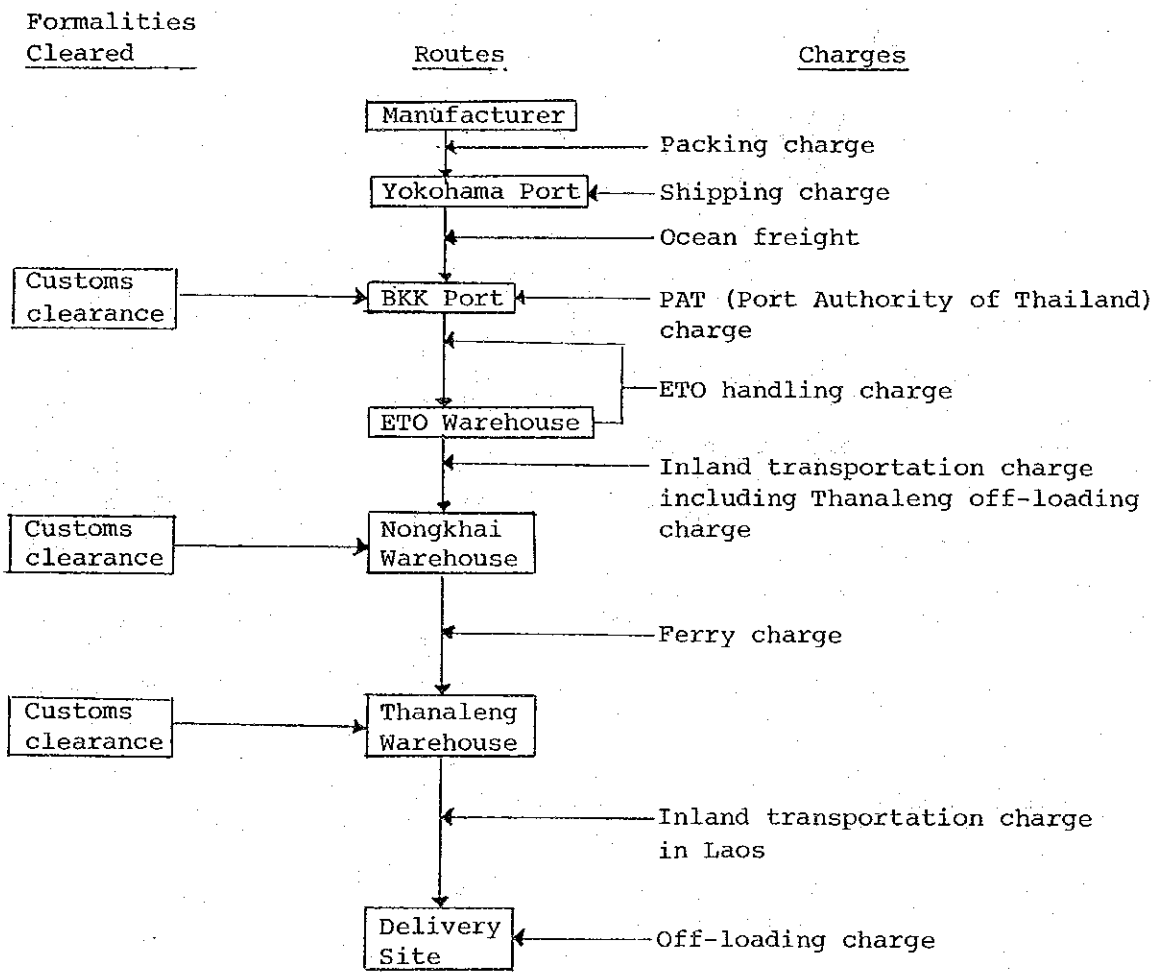
SURVEY ON SHIPMENT OF IMPORTED GOODS

Surveys on shipment of imported goods from Japan to Laos were made to know routes, delivery periods and costs involved since the major materials and equipment are supposed to be supplied from Japan to Laos.

Routes

Shipment of goods from Japan to Laos is shown below:

Fig. 1 Shipment from Japan to Laos



Goods to be delivered are shipped from Yokohama port after being packed and cleared at the Japanese customs. When the goods arrive at Bangkok port, they should be cleared by the Port Authority of Thailand (PAT) and are then handed over to Express Transportation Organization (ETO), monopolistic transportation organization which is handling all goods to be delivered to Laos through Thailand. ETO will then transport the goods to Laos through Nongkhai. At Nongkhai, the goods have to be cleared by the customs authority to go through formalities for export to Laos. The goods may be delivered directly to the site in Vientiane without transshipment at Thanaleng in Laos.

Delivery Period

An estimated time of delivery from Japan to Laos is shown below:

Packing	10 days
Customs clearance	7 days
Shipping	10-14 days
Inland transportation from BKK to the site	14 days

The delivery period from Japan to the site amounts to about 45 days in average.

The delivery period by a manufacture to a purchaser in Japan varies between 1 to 5 months depending on goods ordered. It is reported that the delivery period of vehicles such as dump truck, etc. may take more than 3 months.

Shipping Charge

As shown in Fig. 1, the shipping charge from Japan to Laos consist of various components of charges. The average rates of these components are surveyed as follows:

Table Average Rates of Shipping Charge

Unit: Yen/ton

Item	Amount
Packing charge	10,000
Shipping charge	3,000
Ocean freight	10,000
PAT charge	2,500
ETO handling charge	2,500
ETO inland transportation charge	7,500
Entry charge to Laos	500
Off-loading charge	2,500
Total	38,500

Although these rates are different depending on goods to be delivered, the total shipping charge will amount to 38,500 Yen per ton.

SURVEY ON LOCALLY PRODUCED MATERIALS

Among items of materials locally available, a survey on availability and quality of gravel and sand was made.

Gravel and sand are mainly produced at Thin Thon, 25 km downstream of Vientiane and Nong Thavada upstream of Kaolieo. The gravel and sand are collected from the River during the dry season and are piled along the road. The quantity of gravel and sand is observed sufficient and, therefore, it is reported that the necessary amount of gravel and sand for construction of the proposed reservoirs will be supplied on timely basis if an advance order is placed.

With respect to the size of gravels, it is also reported that suppliers can supply materials of designated size to a certain extent.

The gravel contains some inferior stones which, however, is not considered to impair concrete strength as designed. Oversized stones should be removed by sieving before concreting.

The sand is in general of big size which, however, is not considered to impair concrete strength as designed.

With respect to transportation of materials to the work sites, purchasers have to arrange transportation since the suppliers have no means of transportation.

Following shows the unit prices of locally available materials:

Table Unit Prices of Local Materials

Particular	Description	Unit	Unit Price (Kip)
Gravel		m^3	120
Sand		m^3	80
Brick	4 x 5	1,000 pc	680
Timber	soft wood	m^3	4,000
	hard wood	m^3	5,000
	plywood 9mm	sheet	134
	12mm	sheet	186
Gasoline		l	5
Diesel fuel		l	4
Oil		l	15
Grease		l	28
Electricity		kWh	0.23

Among the above materials, fuel is required to be paid in US dollar currency in accordance with the local law at the official rate of exchange of US$1.00 = Kip 10.

TERMS OF REFERENCE FOR CONSULTINGS SERVICES

I. Objectives

The objectives of the engineering services are to prepare the detailed design, drawings and contract documents for construction of two elevated reservoirs and to carry out a periodical supervision of the construction of the reservoirs.

II. Terms of Reference

The terms of reference for the consultants include, but not limited to, the following:

1) Detailed Designs

The consultants shall carry out detailed designs for construction of two elevated reservoirs with the capacity of 1,500 m^3 each. The detailed designs shall includes preparation of structural calculation, detailed drawings, bill of quantities, cost estimates and other relevant data.

2) Preparation of the Tender Documents

The consultants shall prepare the tender documents and select the lowest evaluated contractor among others through competitive bidding. The documents shall include bidding instructions, bill of quantities, form and conditions of contract, general conditions special conditions, technical specifications,drawings and other relevant documents for construction of the two elevated reservoirs.

3) Assistance in Negotiation of Contract

The consultants shall assist NPP in negotiation of the contract with the contractor who is evaluated as the lowest evaluated bidder in order to arrive at a successful execution of the contract.
In case a tender is called in Japan, the consultants will undertake on behalf of NPP neccessary procedures for advertisement of a tender call, invitation of tenderers, etc.

4) Periodical Supervision

The consultants shall carry out a periodical supervision of construction of the two reservoirs at such intervals that they can be ensured that the work is performed satisfactorily in accordance with the specification of the contract. The supervision shall include inspection of equipment and materials to be incorporated into the work, workmanship and acceptance of the work performed.

5) Reporting

The consultants shall submit the following report in 5 copies each to NPP and the Government of Japan:

a) Inception Report to be submitted within one month after commencement of their services describing the implementation schedule of the Project and disbursement schedule of the project cost.

b) Progress Report to be submitted quarterly describing the progress of the work and problems encountered during the reporting period and the work to be performed for the next quarter.

c) Final Completion Report to be submitted within two weeks after completion of the project together with as-built drawings.

PROCES-VERBAL de discussions sur le Projet d'approvisionnement en eau à Vientiane (Construction de deux châteaux d'eau).

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PREFACE

1. Le Gouvernement du Japon, à la suite de la demande du Gouvernement de la République Démocratique Populaire Lao, a envoyé, par l'entremise de l'Agence Japonaise pour la Coopération Internationale (JICA), la mission d'études dirigée par M.Koji YASHIMA, Secrétaire des Affaires Etrangères du Japon, en vue d'exécuter les études aux fins d'établir un plan de base du Projet d'approvisionnement en eau à Vientiane (ci-après dénommé "Le Projet").

Avant d'entamer les études, la mission a eu des discussions sur le Projet avec les représentants du Ministère des Affaires Etrangères et de la Société des Eaux (Nam Pa Pa) relevant du Ministère des Travaux Publics, des Communications et des Transports.

L'objectif de ce procès-verbal est à la fois de noter les points essentiels parvenus au commun accord entre le Ministère des Affaires Etrangères, Nam Pa Pa d'une part, et la mission d'autre part et de se laisser soumettre aux davantage de considérations des deux Gouvernements.

LE PROJET

2. Ce Projet a pour but de construire deux châteaux d'eau dont leur capacité est respectivement prévue pour 2.000 m^3. Cependant cette capacité sera ultérieurement décidée en conséquence de consultations des deux côtés au moment du retour au Japon de la mission, c'est-à-dire, vers le début du mois de juillet, en tenant compte des résultats des études sur place, de l'avancement des mesures budgétaires du côté japonais etc.

3. Les lieux envisagés pour la construction se trouvent à Phone Thanh et à Phone Tong.

LES ETUDES POUR LE PLAN DE BASE

4. La mission exécute les études conformément aux lignes des travaux décrites dans l' "Inception Report".

5. A la suite de la présentation vers la fin du mois d'août de l'avant-projet de rapport définitif (Draft Final Report, 10 exemplaires en version anglaise) qui comprend la conclusion et les recommandations des études, la mission va venir expliquer sur les substances de cet avant-projet de rapport définitif à Vientiane, à propos duquel Nam Pa Pa donnera son avis à l'Ambassade du Japon en République Démocratique Populaire Lao en moins de deux semaines après la présentation.

6. Le rapport définitif (10 exemplaires en version anglaise) sera soumis en moins d'un mois après la réception de l'avis de Nam Pa Pa sur l'avant-projet de rapport définitif.

7. Nam Pa Pa, durant le séjour en République Démocratique Populaire Lao de la mission, va fournir les données et informations nécessaires et mettre à sa disposition :

- une voiture
- quatre techniciens partenaires (affectés pour la collaboration à plein temps)
- une salle de bureau

ainsi qu'accorder d'autres facilités nécessaires.

LES SERVICES D'ENGINEERING DETAILLE DU PROJET

8. L'engineering détaillé du Projet, à moins qu'il

n'y ait de circonstances particulières, s'exécutera conformément au contrat entre l'ingénieur-conseil qui a participé aux études pour le plan de base, d'une part et Nam Pa Pa d'autre part.

SUPERVISION

9. La supervision de construction de deux châteaux d'eau, à moins qu'il n'y ait de circonstances particulières, s'exécutera conformément au contrat entre l'ingénieur-conseil qui a effectué les services d'engineering détaillé, d'une part et Nam Pa Pa d'autre part.

CONSTRUCTION

10. Au cas où le don serait décidé, la construction de deux châteaux d'eau s'exécutera conformément au contrat entre Nam Pa Pa d'une part et une entreprise de construction japonaise d'autre part, et terminera avant la fin du mois de mars 1983.

ORGANES D'EXECUTION

11. L'organe d'exécution sera Nam Pa Pa, pourtant en ce qui concerne les procédures administratives par voie diplomatique, le Ministère des Affaires Etrangères du Gouvernement de la République Démocratique Populaire Lao va les traiter.

CONTRIBUTION PAR LE GOUVERNEMENT DE LA REPUBLIQUE DEMOCRATIQUE POPULAIRE LAO

12. Au cas où le don du Japon serait décidé, le Gouvernement de la République Démocratique Populaire Lao va exécuter les points suivants :

(1) Assurer le terrain nécessaire pour la construction

(2) Défricher, remblayer et niveler l'emplacement du Projet autant qu'il faut avant le commencement de la construction

(3) Construire et préparer le chemin d'accès à l'emplacement du Projet

(4) Assurer le prompt déchargement et le dédouanement en République Démocratique Populaire Lao des matériaux importés et équipements pour la construction et également faciliter leur transport intérieur

(5) Exempter les ressortissants japonais intéressés des droits de douane, taxes intérieures et d'autres impositions fiscales qui doivent être imposés en République Démocratique Populaire Lao à l'occasion de la fourniture de matériaux et services pour la construction

(6) Pourvoir et accorder les permissions nécessaires, certificats et d'autres autorisations requises pour l'achèvement du Projet

AUTRES

13. Nam Pa Pa a exprimé le vif désir que le côté japonais fasse des efforts pour exécuter le Projet sans délai dans le cas définitif où serait décidé le don du Japon.

VIENTIANE, le 19 Juin 1981

Le Chef de la mission japonaise d'enquête,

Koji YASHIMA

Le Directeur de Nam Pa Pa,

Boualay SOUK ALOUN

Le Représentant du Département II du Ministère des Affaires Etrangères du Gouvernement de la République Démocratique Populaire Lao,

Vannavong PANYA

F I G U I R S

Fig.1 GENERAL PLAN OF VIENTIANE WATER SUPPLY SYSTEM

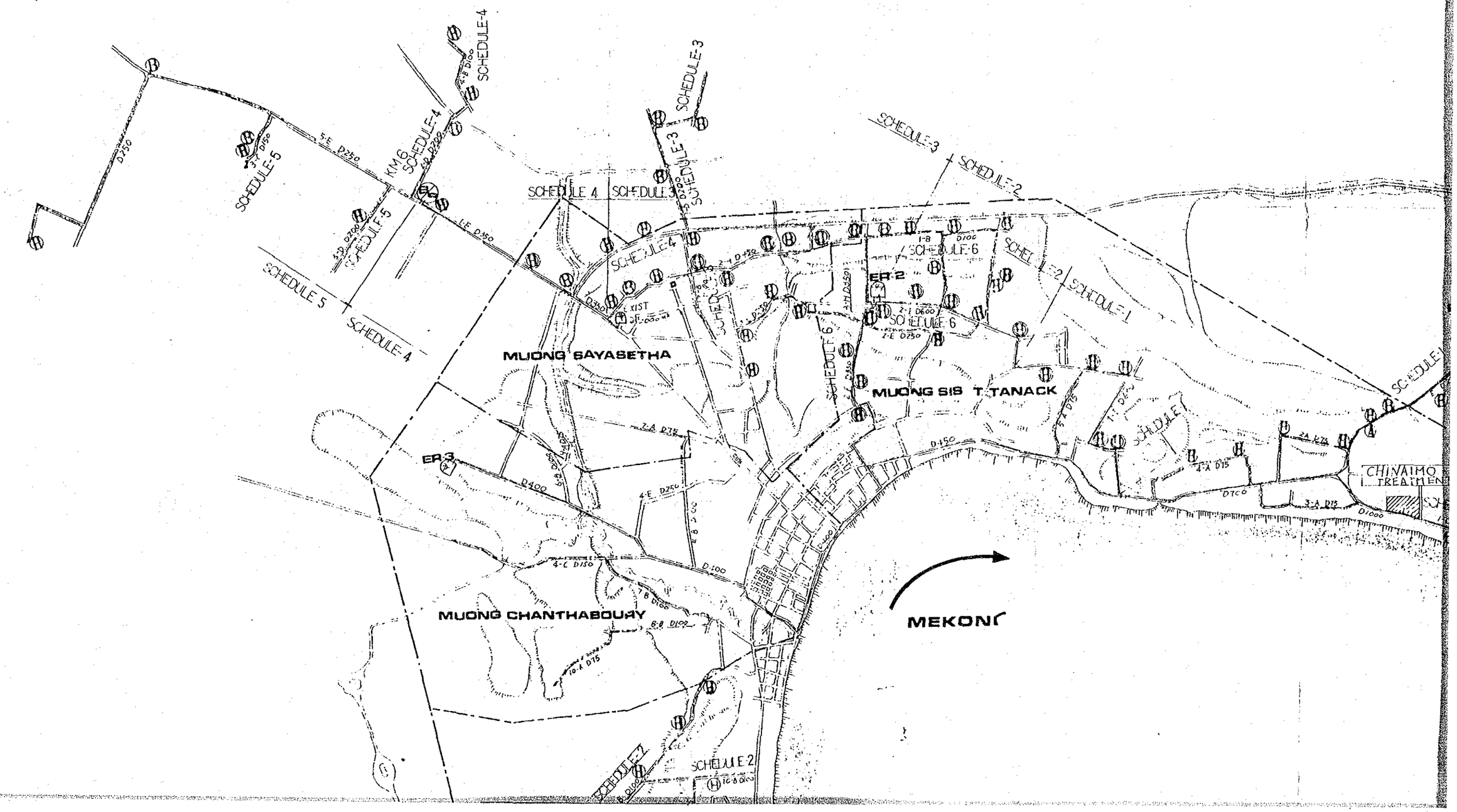
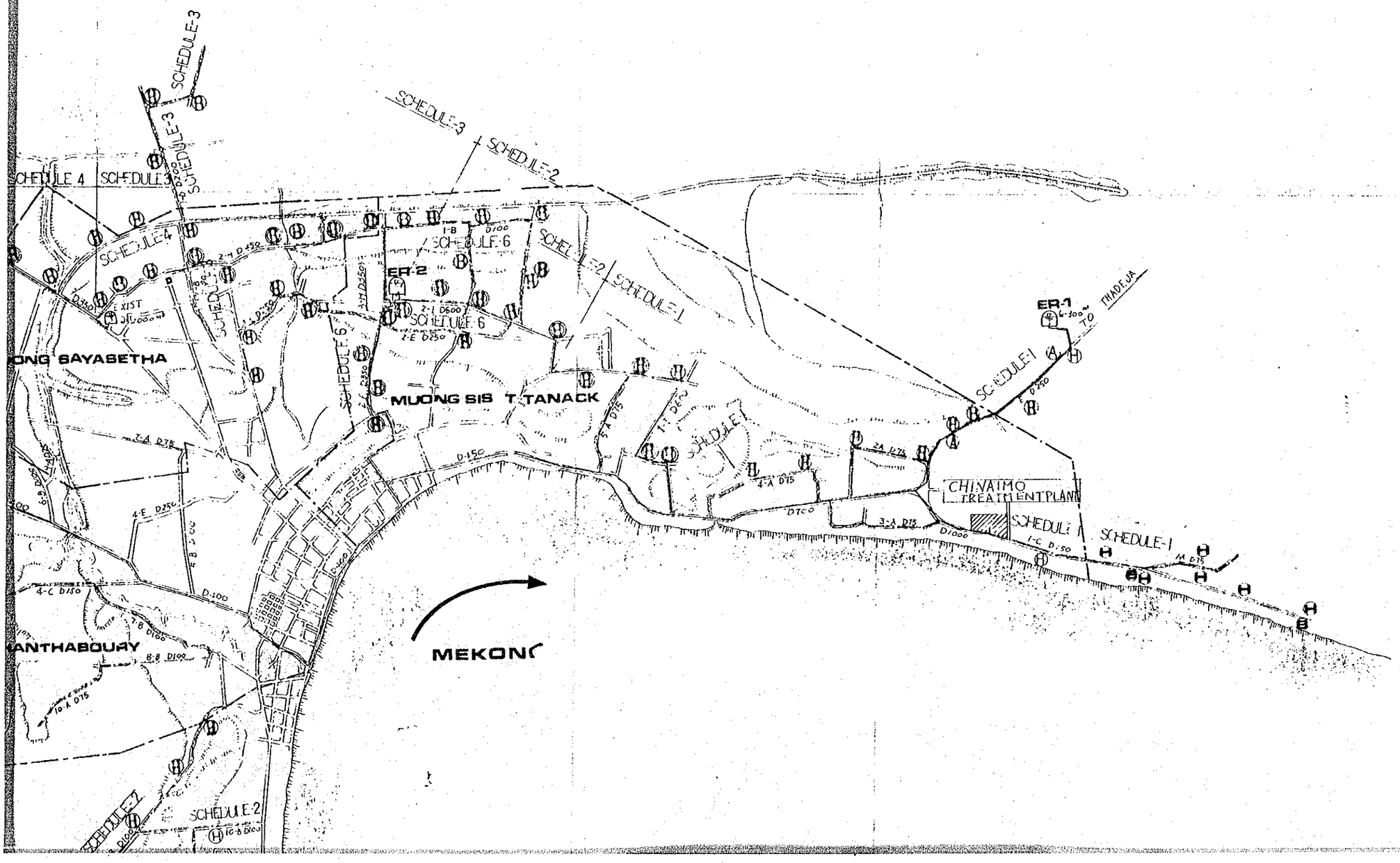
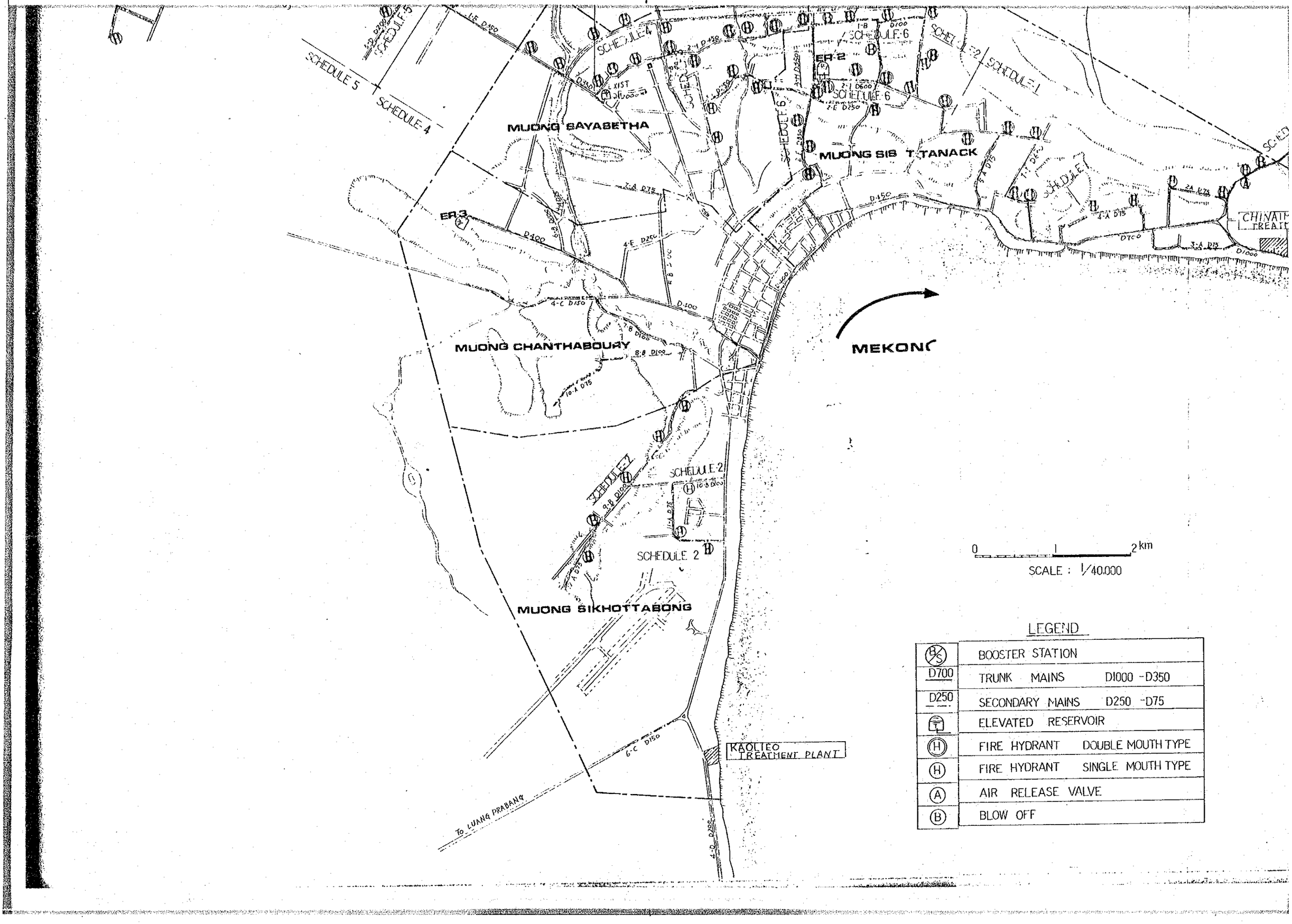
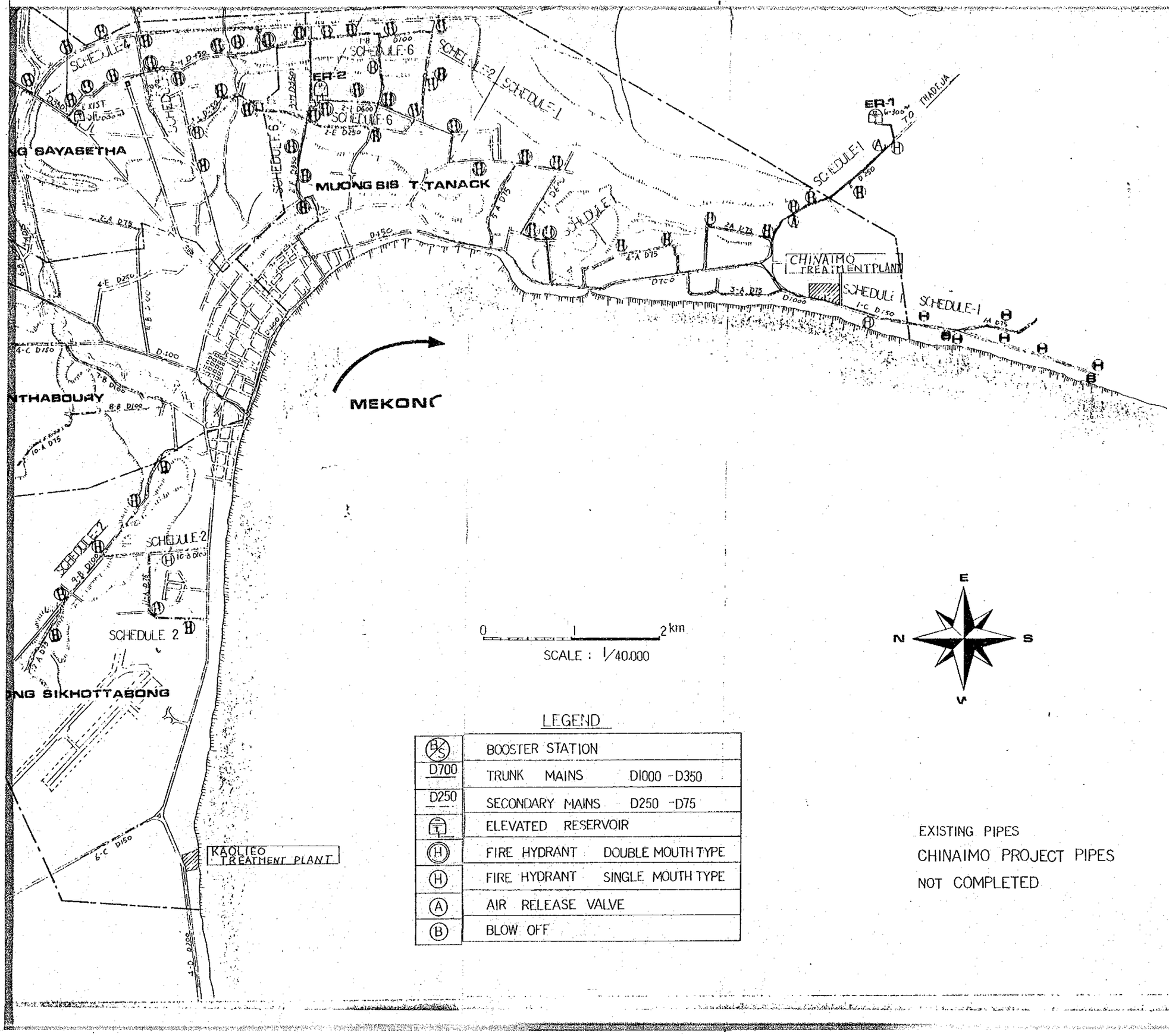


Fig.1 GENERAL PLAN OF VIENTIANE WATER SUPPLY SYSTEM




MUONG SAYABETHA
MUONG SIB T.TANACK
MUONG CHANTHABOURY
MUONG SIKHOTTABONG
MEKONG
ER-1
ER-2
ER-3
SCHEDULE 1
SCHEDULE 2
SCHEDULE 4
SCHEDULE 5
SCHEDULE 6
SCHEDULE 7
KAOLIEO TREATMENT PLANT
To LUANG PRABANG
0 1 2 km
SCALE : 1/40,000
LEGEND
BOOSTER STATION
D700 TRUNK MAINS D1000 -D350
D250 SECONDARY MAINS D250 -D75
ELEVATED RESERVOIR
FIRE HYDRANT DOUBLE MOUTH TYPE
FIRE HYDRANT SINGLE MOUTH TYPE
AIR RELEASE VALVE
BLOW OFF



0 1 2 km

SCALE : 1/40.000

N E S W

LEGEND

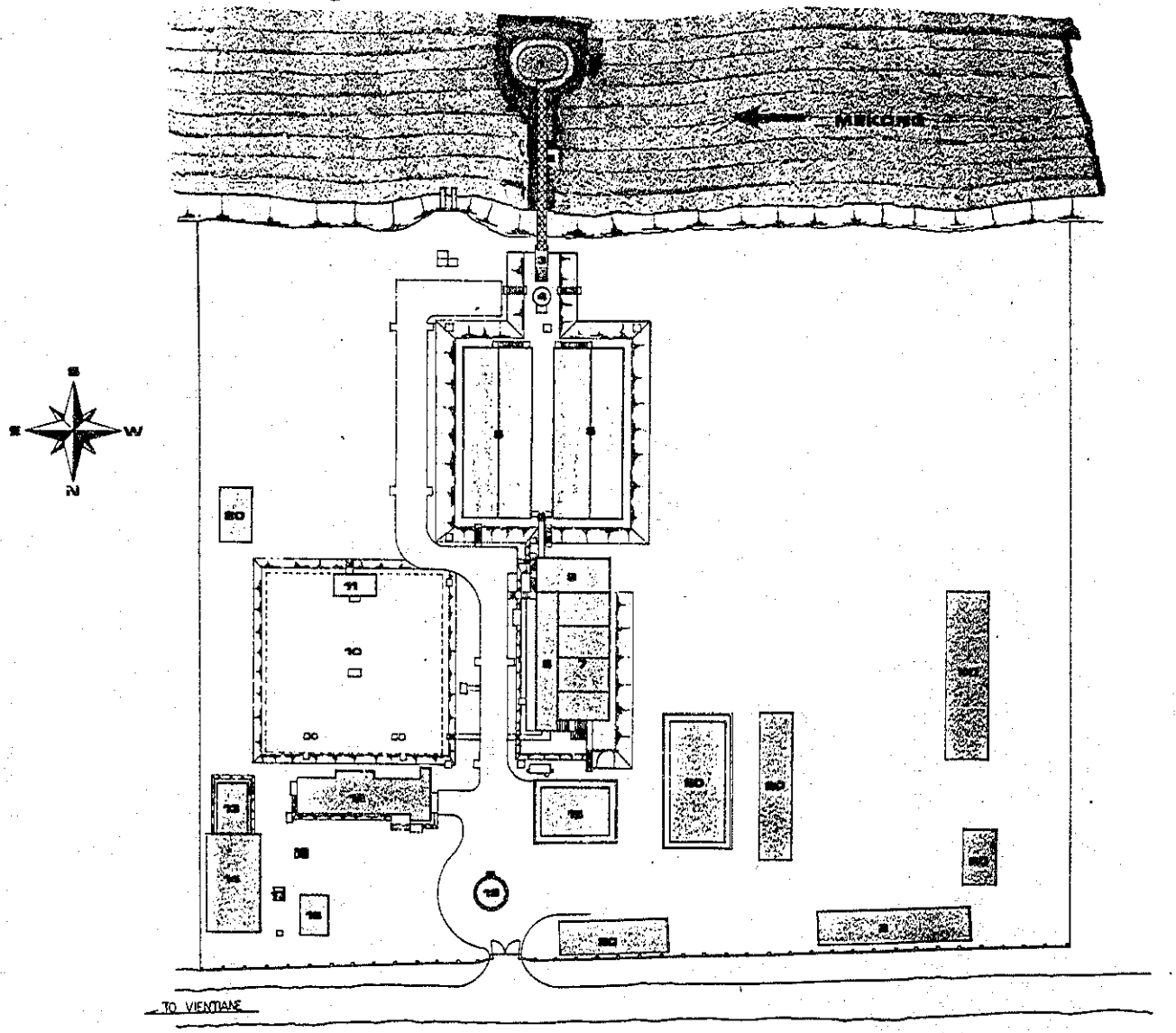
B/S	BOOSTER STATION
D700	TRUNK MAINS D1000 - D350
D250	SECONDARY MAINS D250 - D75
	ELEVATED RESERVOIR
H	FIRE HYDRANT DOUBLE MOUTH TYPE
H	FIRE HYDRANT SINGLE MOUTH TYPE
A	AIR RELEASE VALVE
B	BLOW OFF

EXISTING PIPES

CHINAIMO PROJECT PIPES

NOT COMPLETED

Fig.2 GENERAL PLAN OF KAOLIEO TREATMENT PLANT



1 . INTAKE AND RAW WATER PUMPING STATION
2 . PEDESTRIAN BRIDGE RAW WATER PIPE
3 . ORIFICE METER
4 . FLASH MIXER
5 . SEDIMENTATION BASIN
6 . WATER CONDUIT
7 . FILTERS
8 . OPERATION ROOM
9 . CHEMICAL FEEDING ROOM
10 . RESERVOIR
11 . CHLORINATION ROOM
12 . CLEAR WATER PUMPING STATION
13 . ELECTRIC ROOM
14 . POWER STATION
15 . OFFICE AND LABORATORY
16 . GUARD POST
17 . VENTURI METER
18 . CLEAR WATER FLOW METER
19 . FOUNTAIN
20 . STORAGE

0 10 20 30 40 50m

SCALE : 1/500

Fig.3 GENERAL PLAN OF CHINAIMO TRFATMFNT PLANT

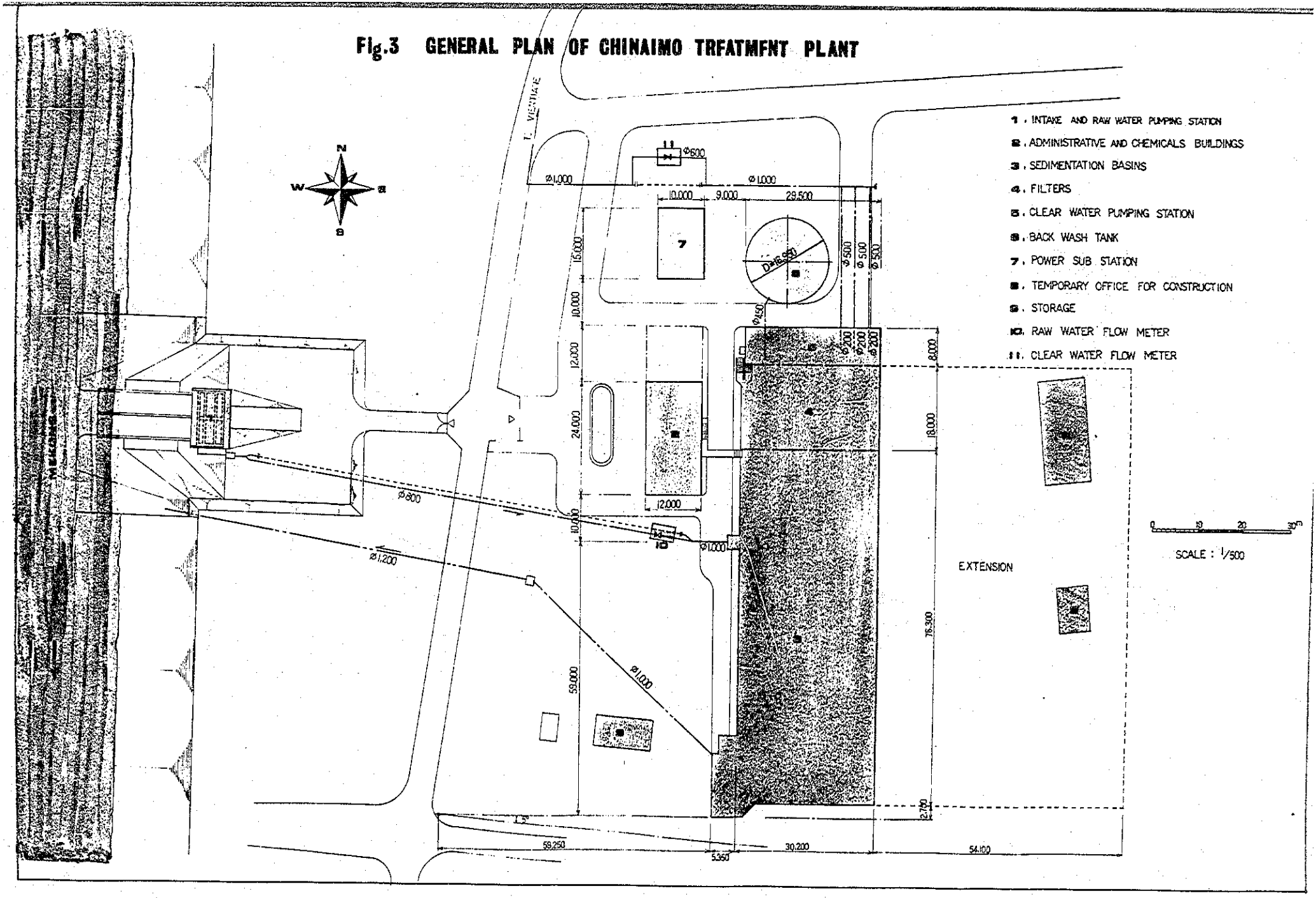
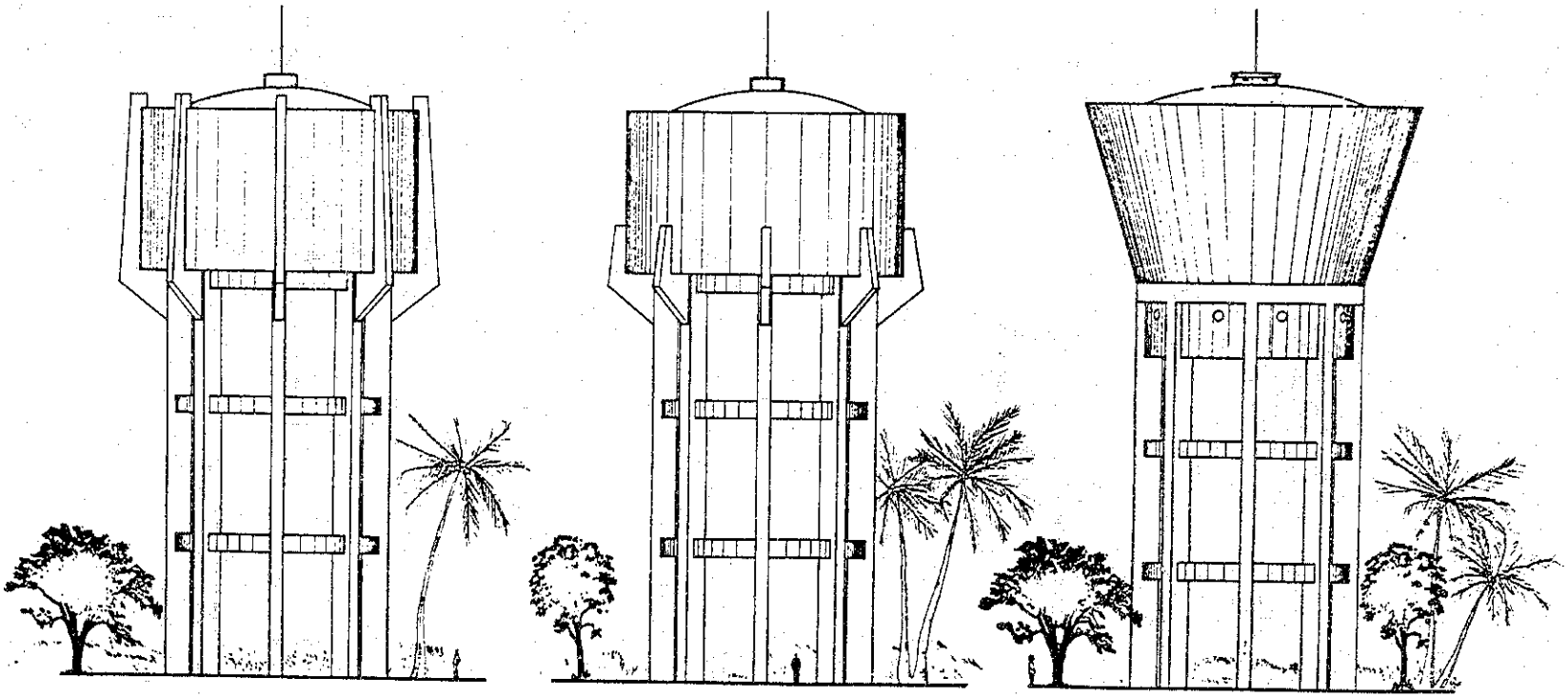


Fig.4 CONCEPTUAL DRAWINGS OF THREE ALTERNATIVES

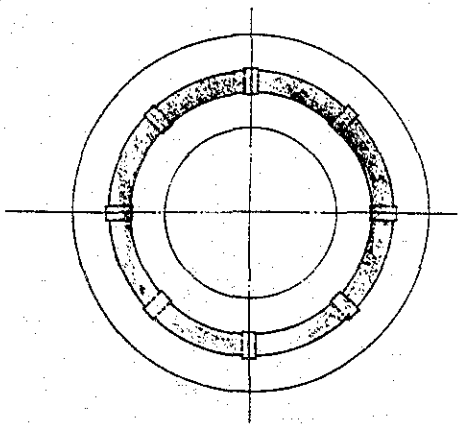


Alternative NO1

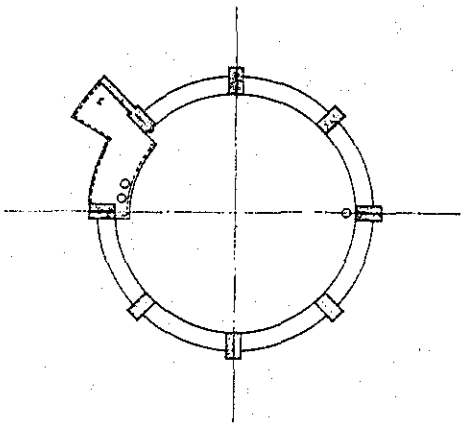
Alternative NO2

Alternative NO3

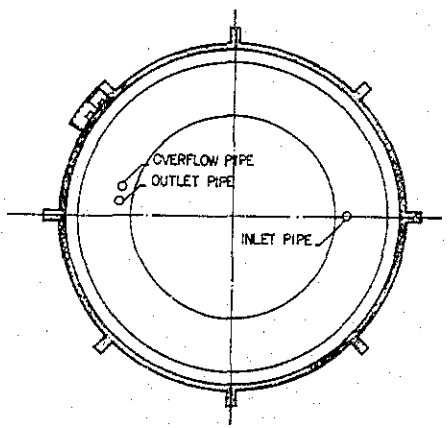
ELEVATED RESERVOIR 1000^{m^3} SCALE = 1/200



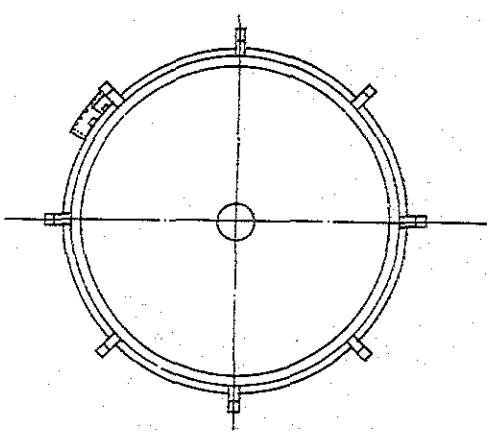
A – A SECTION



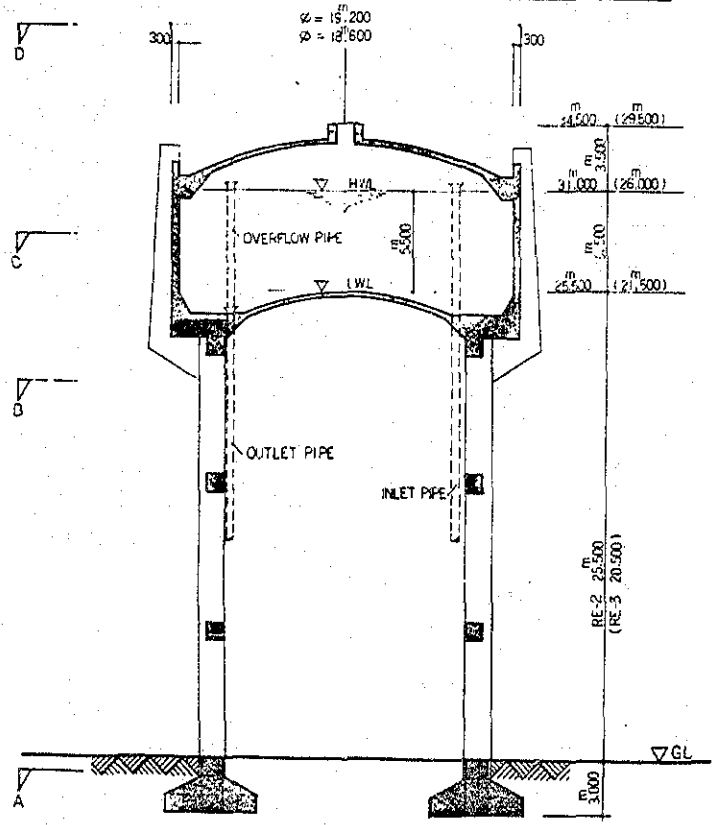
B – B SECTION

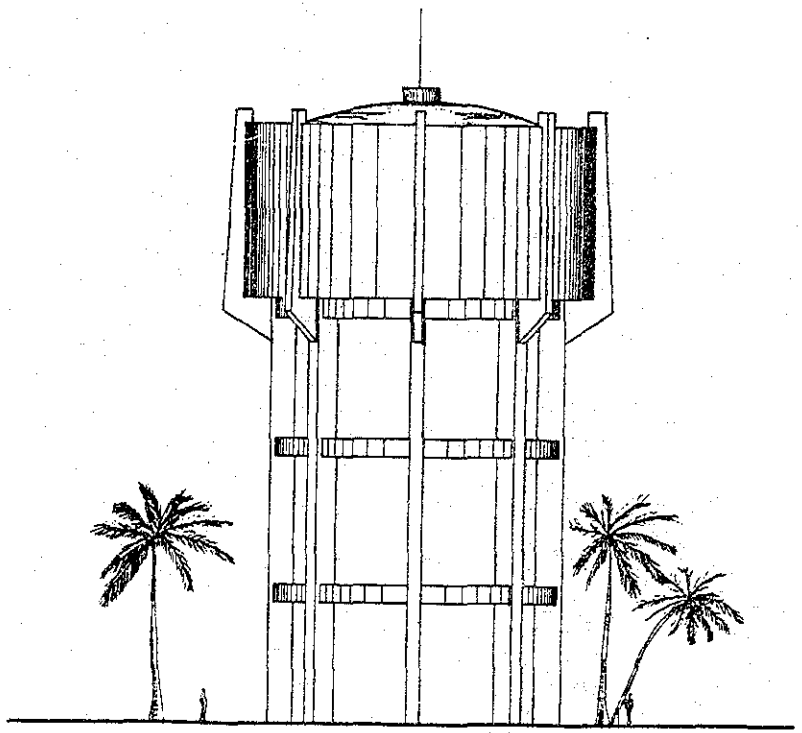


C – C SECTION



D – D SECTION





PROPOSED RESERVOIRS SCALE-1/200
RE-2 (RE-3) 1,500M3